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Environmental Protection Agency, Atlanta, Ga Region IV

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This Draft Environmental Impact Statement (EPA 904/9-77-002) was prepared in response to the proposed action of awarding grant funds to the Grand Strand Water and Sewer Authority for the purpose of developing wastewater treatment facilities to service the Grand Strand Region. The project consists of three wastewater treatment facilities with accompanying outfall lines and interceptor systems. The facilities will process and treat approximately 14.4 million gallons per day of wastewater.

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Horry County
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Salt Marshes
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Intracoastal Waterway

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30308

February 28, 1977

TO ALL INTERESTED GOVERNMENT AGENCIES,
PUBLIC GROUPS, AND CITIZENS:

Today, the U. S. Environmental Protection Agency has made the draft environmental impact statement on the Grand Strand Region, South Carolina Wastewater Treatment Facilities, Project No. C450381, available to the public and to the Council on Environmental Quality. Your copy is enclosed.

Copies of the impact statement are also available to the public for review at

Environmental Protection Agency
Region IV
345 Courtland Street, N. E.
Atlanta, Georgia

Environmental Protection Agency
Public Information Reference Unit
Room 2922, Waterside Mall
401 M Street, SW
Washington, D. C. 20460

Chapin Memorial Library
Myrtle Beach, South Carolina

Horry County Memorial Library
Conway, South Carolina

Horry Georgetown Technical College Library
Highway 501
Conway, South Carolina

A Public Hearing will be held on this draft environmental impact statement Monday, April 11, 1977 at 7:30 p.m. at the South Carolina Public Service Authority Auditorium (adjacent to Myrtle Beach Convention Hall), Oak Street, Myrtle Beach, South Carolina. Registration will begin at 6:30 p.m. Persons wishing to speak will be called upon in order of registration.

Any comments you may have on this statement should be sent by April 29, 1977 to

John E. Hagan, III
Chief, EIS Branch
Environmental Protection Agency
345 Courtland Street, N. E.
Atlanta, Georgia 30308

Jack Ravan
Jack E. Ravan
Regional Administrator

PB 264 059

EPA 904/9-77-002

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

GRAND STRAND REGION, SOUTH CAROLINA

EPA PROJECT NO. C450381

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND ST.
ATLANTA, GEORGIA 30308

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

GRAND STRAND REGION, SOUTH CAROLINA

EPA PROJECT NO. C450381

Environmental Protection Agency
Region IV
345 Courtland Street, N. E.
Atlanta, Georgia 30308

Approved

Jack E. Ravan
Regional Administrator

February 3, 1977
Date

SUMMARY SHEET FOR ENVIRONMENTAL IMPACT STATEMENT

GRAND STRAND REGION, SOUTH CAROLINA

EPA PROJECT NO. C450381

Draft (X)

Final ( )

Environmental Protection Agency
Region IV
345 Courtland Street, N. E.
Atlanta, Georgia 30308

1. Type of Action: Administrative (X)
Legislative ( )

2. Brief Description of Proposed Action

The subject action of this Environmental Impact Statement is the awarding of grant funds to the Grand Strand Water amd Sewer Authority for the preparation of plans and specifications for regional wastewater treatment facilities to service the Grand Strand 201 area. The project consists of three wastewater treatment facilities with accompanying outfall lines and interceptor systems. Plant A will be a 6.0 MGD facility discharging into the Intracoastal Waterway. Plants G and C will have capacities of 6.0 MGD and 2.4 MGD respectively discharging into the Waccamaw River.

3. Summary of Major Environmental Impacts

The proposed action will have the following beneficial impacts:

(1) Alleviation of existing adverse conditions caused by low quality wastewater discharges.

(2) Wastewater treatment facilities to accommodate existing and future sources of wastewater.

(3) Allowance of orderly growth in the Grand Strand area.

The proposed action will have the following adverse impacts:

(1) Potential erosion of treatment plant sites and interceptor routes during construction.

(2) Minor decrease in biological productivity of the floodplain from construction and operation of Plant C.

(3) Temporary noise and odor impacts during construction.

(4) Potential of Plant C for incompatibility with Litchfield Country Club Community.

(5) Potential burden of proposed action on solid waste disposal system.

4. Summary of Alternatives Considered

A total of 13 basic regional wastewater treatment plant configurations were identified. These configurations included combinations of 1, 2, 3, and 4 regional treatment plants with continued use of various existing plants. A detailed description of each of these alternatives is presented in Section 4.2.4.2.

The initial analysis of the above 13 alternatives resulted in the selection of a three region plant system with all plants having secondary treatment. However, problems with the water quality model used as a basis for the development of these alternatives led to the development of seven additional treatment alternatives. These alternatives included various combinations of advanced wastewater treatment with discharge into the Intracoastal Waterway and land application of effluent from Plants A and MB-1.

5. Comments on the Draft Statement have been requested from the following:

Federal Agenices

Bureau of Outdoor Recreation
U. S. Coast Guard
Corps of Engineers
Council on Environmental Quality
Department of Commerce
Department of Health, Education and Welfare
Department of the Interior
Department of Transportation
Department of Housing and Urban Development
Economic Development Administration
Federal Highway Administration
Fisheries and Wildlife Service

Federal Agencies (Continued)

Food and Drug Administration
Forest Service
Geological Survey
National Park Service
Soil Conservation Service
Federal Energy Administration
Federal Power Commission

Members of Congress

Honorable Strom Thurmond	U. S. Senate
Honorable Ernest F. Hollings	U. S. Senate
Congressman John W. Jenrette, Jr.	House of Representatives

State

Honorable James B. Edwards, Governor, State of South Carolina
S. C. Department of Health & Environmental Control
State Clearinghouse, Division of Administration
South Carolina Forestry Commission
State Archives Department
Institute of Archeology and Anthropolgy
S. C. Ports Authority
S. C. Coastal Zone Planning & Management Council

Local

Mayor, Myrtle Beach, S. C.
Mayor, Georgetown, S. C.
Board of Commissioners, Georgetown County, S. C.
City Engineer, Georgetown, S. C.
Waccamaw Regional Planning & Development Council
Mayor, Conway, S. C.
Board of Commissioners, Horry County, S. C.
City Engineer, Myrtle Beach, S. C.
Horry County Development, Planning & Tourism Commission
Grand Strand Water & Sewer Authority

Interested Groups

S. C. Wildlife Federation
S. C. Wildlife & Marine Resources Commission
S. C. Land Resources Conservation Commission
Trout Unlimited
Governor's Beautification & Community Improvement
League of Women Voters of South Carolina
S. C. Environmental Action, Inc.
Garden Clubs of South Carolina
Keep South Carolina Beautiful, Inc.
Columbia Audubon Society
S. C. Association of Counties
Advisory Council on Historic Preservation
Natural Resources Defense Council
Friends of the Earth
Environmental Defense Fund
North Myrtle Beach Environmental Association

6. Date made available to CEQ and the Public

The Draft Statement was made available to the Council on Environmental Quality and the public during February, 1976.

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SUMMARY

I. INTRODUCTION AND BACKGROUND

This chapter defines the legal basis and the scope of the environmental impact statement, and presents an overview of the planning area and the proposed project. In the interest of focusing the environmental impact statement on key environmental issues, the final section of this chapter identifies the significant impact issues which are dealt with in the EIS.

1. LEGAL BASIS FOR THE EIS

The U.S. Environmental Protection Agency (EPA) is the administering agency for a major Federal environmental program entitled "Grants for Construction of Treatment Works."* This program allows the EPA administrator to provide financial aid to any state, municipality, intermunicipal agency, or interstate agency for the construction of publicly owned water pollution control facilities. The program will encourage reduction of point sources of water pollution and improve national water quality.

The EPA's granting of funds for a water pollution control facility may require an EIS. Each proposed water pollution control facility is evaluated on a case-by-case basis by the appropriate EPA regional office to determine whether the proposed facility is expected to have significant environmental effects and whether the system proposed appears to be a cost-effective solution to area water quality problems.

The EIS is being issued pursuant to P.L. 91-90, the National Environmental Policy Act (NEPA) of 1969, and Executive Order 11514, "Protection and Enhancement of Environmental Quality" dated March 5, 1970. Both NEPA and Executive Order 11515 require that all Federal agencies prepare such statements in connection with their proposals for major Federal actions significantly affecting the quality of the human environment.

This has been prepared in accordance with the regulations and guidance set forth in the President's Council on

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* Authorized by Title II, Section 201 (g(1), of the Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500 (FWPCA.A).

Environmental Quality (CEQ) Guidelines dated August 1, 1973 and the EPA's Final Regulations 40 CFR-Par 5, dated April 14, 1975.

2. SCOPE OF THE EIS

The EIS addresses the alternatives for meeting water quality standards in the 400 square mile coastal area surrounding Myrtle Beach, South Carolina. Alternatives and impacts considered include the following:

- Central sewage treatment vs. use of septic tanks and package plants to meet areawide growth
- Number and location of centralized sewage plants
- Effluent disposal from centralized plants
- Sludge disposal
- Construction impacts from building sewage plants, interceptors, and outfalls
- Secondary community impacts resulting from growth in the study area.

The question of controls for non-point sources of pollution (e.g. surface runoff) is being dealt with separately under the areawide wastewater management planning effort currently underway in accordance with Section 208 of the 1972 Water Quality Act amendments.

In order to assess the environmental impacts of the proposed action, a careful review and evaluation was made of historical and projected population growth. Questions were raised regarding the projected population base to be served by sewage treatment facilities. Revised population estimates were prepared for the tourist and permanent population sectors which reflect an overall reduction in population growth in the planning area. These estimates were based on several factors including:

- Tourism activity levels
- Accommodation occupancies representative of major southeast coastal resort areas and properties
- Building permit data
- National and local household size trend data
- Market factors relating to development curves for primarily resort and second home development areas.

The alternatives considered included a range of from one to four regional wastewater treatment plant concepts, coupled with utilization of existing facilities, which were considered suitable for expansion and/or upgrading.

In accordance with recent EPA and Council on Environmental Quality instructions, efforts have been made to identify the key environmental issues related to the proposed plan, and to focus the environmental impact statement on these critical questions.

3. OVERVIEW OF THE PLANNING AREA

The Grand Strand sewer planning area is roughly defined as the land area in Georgetown and Horry Counties lying between the Intracoastal Waterway and the Atlantic Ocean. It encompasses four county census districts, three in Horry County, and one in Georgetown County.

Within the planning region, there are three areas with unique characteristics. Area 1 in Horry County has intensive commercial, residential, and recreational development along the Atlantic Ocean. Its growth and environmental problems are the most advanced. Area 2 in Georgetown County has development similiar to Area 1, but is somewhat protected from rapid growth and seasonal change by the presence of large open areas. Area 3 combines commercial and institutional development along U.S. 501 with residential development between Nixon's Crossroads and the Little River. Although the remainder of the area is undeveloped, the International Paper Realty Corporation has begun to plan development for the Buist Tract.

Community services are provided by a combination of State, county, and municipal agencies. The Waccamaw Regional Planning and Development Council is a non-governmental organization which initiates and coordinates planning and development for a seven-county region which includes Georgetown and Horry Counties. The Council is also the designated A-95 agency for reviewing federally funded projects. The planning area is served by motor transport (automobiles, trucks, busses) and aviation. There is no mass transit system. Water and sewage services are coordinated by the Planning Council, Grand Strand Water and Sewer Authority, Horry County Water and Sewer Authority, and Georgetown County Water and Sewer District.

4. PROJECT BACKGROUND

The Grand Strand Water and Sewer Authority is applying for a Federal grant to build wastewater treatment facilities for the Grand Strand area of Horry and Georgetown Counties in South Carolina. The proposed plan has as its main goal provision for adequate treatment and disposal of the areas wastewaters, both now and to meet the needs of the growing permanent and tourist populations. Specific objectives include:

- Elimination of public health risks associated with existing treatment facilities
- Opening of certain closed shellfish areas
- Attainment of water quality standards in the Intracoastal Waterway and the Waccamaw River.

The existing regional treatment system consists of ten municipal plants, the Myrtle Beach Air Force Plant, approximately sixty package plants, three industrial wastewater treatment plants, thousands of septic systems, and numerous sewage lagoons. Much work has already been done in the development of this system to attack surface water quality problems. However, critical water quality problems remain in the several major waterways in the area, and in coastal wetlands.

The Grand Strand Water and Sewer Authority was created on June 2, 1971 to deal with the area's problems of water pollution and wastewater management. Work on the plan began in January 1974 and a draft plan was made available for public review in May 1974. The planning area was divided into three separate service areas accommodating the three new regional treatment plants which comprise the final plan—treatment plant A, approximately two miles inland from Atlantic Beach in the north; treatment plant G, in-shore from Garden City and Surf Side, near highway 544 in the coastal section of Horry County; and treatment plant C, located on the site of the present Litchfield beach plant, just inland from Litchfield beach in the south.

The facilities proposed in the 1974 plan incorporated the following features:

- Secondary treatment of wastewater
- Flow equalization or modular treatment units to accommodate high seasonal flows
- Discharge of effluent in the first two phases of construction to the Intracoastal Waterway
- Sludge disposal by spraying of liquid sludge on golf courses
- Location of transmission lines, primarily on roadway rights of way
- Phasing of construction to meet expected patterns of growth and water quality needs.

EPA determined that an Environmental Impact Statement was required for the proposed action, and preparation for such a statement began in July 1975. In November 1975, questions were raised regarding water quality in the Intracoastal Waterway as affected by effluent discharges from the northern plant A and the central plant G. The environmental impact analysis was suspended with the following additional activities taking place:

- Water quality modeling studies of the Intracoastal Waterway were conducted
- Size of the wastewater treatment plants was scaled down in accordance with the population projections.

- Seven modified alternatives were developed and evaluated for the north service areas. The most significant of these alternatives was an effluent disposal method using spray irrigation of golf courses and rural land.

In October 1976, efforts were resumed to complete the Environmental Impact Statement on the entire plan.

5. SIGNIFICANT IMPACT ISSUES

(1) Water Quality

Water quality is of concern in the Grand Strand region in four areas:

- The Intracoastal Waterway
- The Waccamaw River
- Certain coastal wetland shellfishing areas
- Beaches.

Water quality sampling in the Intracoastal Waterway in April and August 1972 gave the following results. During April, the mean total and fecal coliform densities were recorded as follows:

COLIFORM DENSITY MPN*/100 ml	LOCATION (From Myrtle Beach Waste Discharge)	
	UPSTREAM	DOWNSTREAM
TOTAL	540	4700
FECAL	59	1100

The largest waste discharge occurred from the lower Myrtle Beach oxidation pond about 3¼ miles downstream from the Myrtle Beach Air Force Base discharge.

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* MPN = most probable number of organisms

During the peak tourist season in August, the corresponding results were as follows:

COLIFORM DENSITY	LOCATION	
	UPSTREAM	DOWNSTREAM
TOTAL	700	67,000
FECAL	59	3,400

Class A standards for fecal coliforms call for a maximum of 200 MPN/100 ml.

A water quality model of a 36 mile segment of the ICWW from the Little River Inlet to the junction with the Waccamaw River was developed. Results are presented in Figure I-1 for this 36 mile segment for July low flows for the case of no point source discharges. Because of limited data the accuracy of these results is considered questionable. Nevertheless, results indicate that DO standards might be marginally met with no discharges.

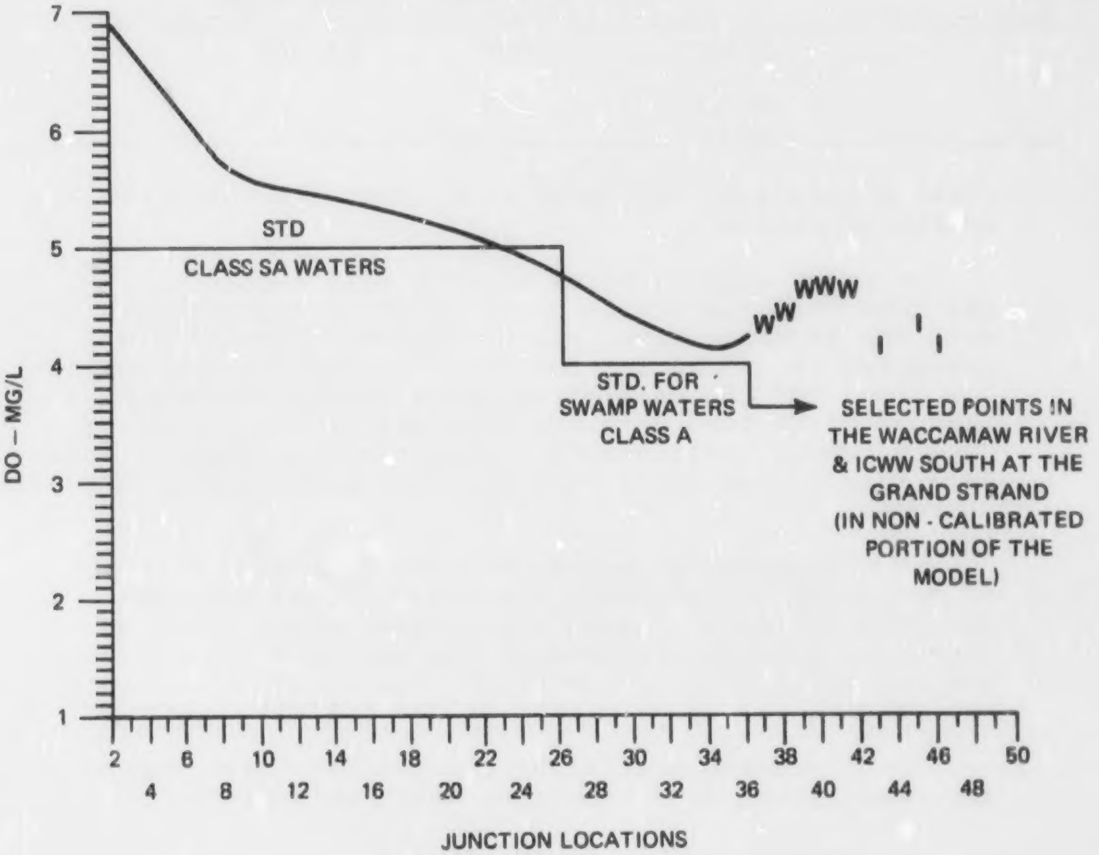
The Waccamaw River, downstram of Conway to the Route 17 bridge, violated dissolved oxygen and fecal coliform criteria. Since the central plant G was designed to have its outfall to the Waccamaw River, water quality standards and associated wasteload allocations are critical to the location of the outfall.

Four primary shellfishing areas have been closed in recent years as a result of water pollution:

- All of Little River Estuary
- All of the Midway Inlet up to the headwaters of the northern area of Midway Inlet
- All of Parsonage Creek to its conjunction with Allston Creek at Weston Flat at Murrell's Inlet
- All of Winyah Bay, up to the southern portion of North Island.

Figure I-1

Myrtle Beach Grand Strand ICWW
July Low Flow DO Profile
No Point Sources



0 – LITTLE RIVER INLET
4 – SC WELCOME CENTER
11 – OCEAN DRIVE WTP
15 – PROPOSED A PLANT
25 – PROPOSED MB-1
29 – WATERGATE S/D WTP
30 – WOLVERINE BRASS WORKS
36 – JUNCTION WITH WACCAMAW RIVER

In addition, Murrell's Inlet is open on a conditional basis. Closings occur automatically when three inches or more of rain falls, or when monitoring results so indicated. A primary objective of the wastewater facilities plan is to reduce septic tank use and improve the effluent quality of wastewater facilities, to provide for reopening of these shellfishing areas.

The 208 effort recently has documented high fecal counts on beaches in the City of Myrtle Beach. This has resulted in a recommendation to the City Council that the beaches be closed after rainstorms of three or more inches. This finding is in contrast to a limited study by EPA in September 1972, which showed that bacterial quality was within State standards and a 1973 beach sampling by the South Carolina Department of Environmental Control which found that no maximum exceeded fecal coliform levels of the State's primary contact standard.

(2) Projected Growth

The area includes two populations—a year-round permanent population and a transient tourist population. During the period 1960-1970, population in the planning area grew approximately 20 percent, a higher rate than the county-wide growth rate of either county. During this period, the population of Georgetown County declined. Since 1970, the two counties have experienced greater growth, largely as a result of the growing tourist economy.

In 1972, approximately 10 million people visited the Grand Strand. On the basis of the total transient accommodation units available and the number of persons per unit, the Waccamaw Regional Planning and Development Council estimated the number of overnight visitors and day visitors and the total peak day population at 232,000.

Since interviews with city and regional planning officials and chamber of commerce representatives from Florida and New Jersey resort areas indicate that the WRPDC estimates of occupants per motel unit (4) and cottage unit (9) were high, a more realistic 1972 peak population would be 184,716 based on a rate of 2.5 persons per motel unit and 6 persons per cottage. However, since this revised 1972 peak population figure is an estimate only and was not confirmed by an actual survey, the EIS has utilized the WRPDC figure of 232,000 and occupant per unit rates as a baseline for the summer (peak) population projection.

In reviewing the permanent population projections, the EIS study compiled and examined an EPA estimate (1972), a LBC&W estimate (1972) , and a Waccamaw Regional Planning and Development Council (1974) study. The analysis showed that both EPA and LBC&W had relied heavily on historical trend data, and WRPDC study had focused on recent trends. As a result, both the short and long term growth trends were revised downward. For 1972-1977 period, the WRPDC population projection was 40,702 for the permanent population, and 292,748 for the summer population. The revised estimate for that period is 38,000 for the permanent population, and 290,046 for the summer population. The WRPDC estimate for 1997 was 149,641 permanent residents and 634,210 summer residents. The EIS projections are for 103,175 permanent residents and 498,418 summer residents.

(3) Treatment Configuration and Construction

The Grand Strand area is served by a proliferation of small municipal treatment facilities, package plants, and septic tanks. Because of its popularity as a resort area, continued growth is anticipated. The problems addressed in the 201 Facilities Plan and in the alternatives analysis section of this EIS, deal with the development of the most effective area-wide treatment system. Major issues include the following:

- What are the real growth requirements which must be met?
- Can the present configurations, supported by additional septic tanks and package plants effectively meet the anticipated growth?
- Will interceptor construction and plant construction disrupt the natural or manmade environment?
- If central treatment plants are to be built, how many should be built, where should they be located, and what treatment technology should be used?
- How can liquid effluent from wastewater plants be most effectively disposed of?

(4) Sludge Disposal

The primary issue raised with regard to the disposal of municipal sewage sludge relates to the direct application of digested sludge on land areas, including golf courses and other green areas, compared with composting or land fill as the two primary alternatives.

(5) Secondary Impacts Resulting from Growth

A central issue in the construction of new wastewater treatment facilities is whether the added capacity, in itself, will induce growth beyond that which might occur under the no action alternative. Under the no action alternative, it is assumed that septic tanks would continue to be used in suitable areas (but with more stringent enforcement of size and maintenance requirements) and that package plants would be used to meet new community needs. If induced growth seems likely, one can attribute the community effects of this growth to a secondary impact of the plan.

Impacts of growth on the community can be expected in the following areas:

- Need for increased community services
- Increased transportation congestion resulting in a demand for improved roads and a decrease in air quality
- Reduction of open spaces resulting in a loss of elements of the natural environment.

(6) Ecological Impacts of Growth

Biological impacts may be experienced from continued development of vacant and wooded lands. The increased vehicular traffic and normal activities of an increasing population will cause additional dust and pollutant loading in the air and streams. Poor land development practices and alteration of natural drainage patterns could eventually cause a gradual disappearance of the more delicate tropical plant species found in the Grand Strand area, unless appropriate mitigative measures are applied.

(7) Local Share of Costs

As in any public works program, the ability of the community to meet its share of construction costs, and the total annual cost of operation, is of concern. The added cost to the community compared with the additional revenue generated by the increased population, must be evaluated.

The ability to finance or support these improvements will depend upon several factors including:

- Increases in the assessed valuation of real property.
- Median income of permanent population
- Changes in tourist spending patterns and activity levels
- Federal and State grant and funding programs.

II. EXISTING ENVIRONMENT RELATED TO SIGNIFICANT IMPACT ISSUES

1. DEMOGRAPHY, LAND USE AND ECONOMICS

(1) Demography and Land Use

The planning area consists of three sections which each have distinctive demographic and development characteristics. They vary in density of development as well as in land use patterns. The higher density occurs along the Atlantic Ocean, particularly in the City of Myrtle Beach which contains commercial development and several condominium projects. Along Route 17, opposite the ocean, much land is undeveloped. That which is developed is used for commercial and residential uses at a much lower density than the ocean-front land. Beyond the Intracoastal Waterway, developed land is devoted to manufacturing and institutional facilities. Much of this area is currently undeveloped forest and open space.

(2) Economics

The planning area has four principal economic activities of which tourism is the most important. Since the area offers year-round recreational opportunities, the structural development (hotels and restaurants) lends a more permanent appearance than similar resort areas at coastal beach communities in the north.

In addition to its importance as a source of employment, the tourism industry brings money into the community. Tourist spending on the Grand Strand reached nearly $400 million in 1972. This money flowed from Grand Strand retail and service establishments to manufacturers and suppliers, thereby generating dollars in trade and payroll in other economic sectors.

Manufacturing is the second most important economic sector. It includes milled lumber, food processing, printing, and production of furniture, textiles and clothing. Of the two counties, Georgetown County is most dependent on manufacturing. In 1973, manufacturing accounted for 22 percent of the total county-wide industrial payroll of $110 million. Between 1970 and 1973, both Georgetown and Horry Counties added new manufacturing units at a faster rate than the state rate, although Georgetown County lags behind Horry County and the State in adding new employees.

Agriculture has little economic importance to the planning area, but still plays an important role in other areas of the two counties. Major products are tobacco, eggs, soybeans, and lumber. Fulltime agricultural employment levels have declined.

Peak seasonal flow is three to six times greater than permanent population flow. This places excessive loads on existing treatment facilities, including septic tanks, during March through September. Many existing systems fail to perform at their designed capabilities due to poor operation and maintenance.

2. TERRESTRIAL BIOLOGICAL COMMUNITY

Among the 150 or more species of trees, woody vines, shrubs and other vegetation in the planning area are several rare or infrequent types. These types occur in small numbers and in restricted areas. Although not necessarily threatened with immediate extinction, these species may require special care.

The large variety of Grand Strand region wildlife includes both common and rare or endangered species of reptiles, birds, and mammals. Over 100 species have been sighted, many of which are established residents. Both established and migratory wildlife rely upon the habitats provided by the area's natural vegetation.

3. WASTEWATER TREATMENT SYSTEM

There are six major municipal wastewater treatment plants in the planning area which constitute 80 percent of the total plant capacity of the area. These plants together with their designed capacity and their effluent receiving stream are summarized below.

PLANT	DESIGN CAPACITY MGD	RECEIVING STREAM
MB-1	6	ICWW
NMB-1	1	"
NMB-2	1.2	"
AF-1	0.75	"
LB-1	0.5	Waccamaw River
MB-2	0.4	ICWW

The first five plants are possible interim or permanent regional treatment plants for the new wastewater treatment plan. The sixth (MB-2) is a major pollution source and the Facilities Plan has recommended that it be abandoned as soon as possible.

4. WATER QUALITY

(1) Surface Water

The two major surface water bodies in the Grand Strand area under study are the Waccamaw River and the Intracoastal Waterway. Most of the Intracoastal Waterway was formed by dredging Little River, which flows northeasterly, parallel to the coast and empties into the Atlantic Ocean through Little River Inlet. In the vicinity of Myrtle Beach, the Intracoastal Waterway was constructed by dredging a channel between the Little River and the Waccamaw River. In addition to these two bodies of water, water quality has been of concern as a result of certain closed shellfishing areas, and potential contamination of some beach waters. A summary of the water quality status for each of the above four areas is presented in the following sections

1. Waccamaw River

The fresh water reaches of the Waccamaw River have been classified as Class A, by the South Carolina Pollution Control Authority. Class A Standards require that fecal coliforms must not exceed a geometric mean of 200 counts per 100ml, and that the dissolved oxygen must not be less than 5mg/l. These standards are not met at a number of sampling stations along the river but South Carolina Water Classification Standards state that standards will not be considered violated when values outside the established limits are caused by natural conditions. This appears to be the case for the ICWW. There is a reason to believe that the entire stretch of the river from Conway to a point about one mile below the confluence with the Intracoastal Waterway does not meet Class A standards. The primary municipal contributor would be Conway which is outside the planning area.

2. Intracoastal Water

The ICWW from the North Carolina state line to the saltwater line within Georgetown County is classified as Class A. Field studies in April and August 1972 showed that total and fecal coliform density exceeded standards as a result of municipal plant waste discharges into the waterway. The largest waste discharge originated with the Lower Myrtle Beach oxidation pond (See Chapter I Section 5).

3. Shellfishing Areas

Shellfishing has been closed in the areas of Pawley's Island, Litchfield Beach, Little River Estuary, Cherry Grove Inlet, Midway Inlet, Parsonage Creek, and Winyah Bay. Murrell's Inlet is open on a conditional basis. These areas have been closed as a result of discharges from oxidation ponds, treatment plants, inadequate or malfunctioning septic tanks, and urban runoff.

4. Beach Waters

The bacterial quality of the majority of the bathing beach waters sampled by the Environmental Protection Agency in September 1972 were within the recommended South Carolina standards for primary contact recreation. Approximately half of the stations sampled were in violation of the Class SA bacterial standard, as a result of creeks and swashes discharging to beach areas, as well as the discharge of effluent from some existing waste treatment facilities.

(2) Ground Water

In the Grand Strand-Conway area north of Little River, the water table aquifer furnishes water for most domestic supplies. Chemical analysis of this water indicates conformance to U.S. Public Health Service drinking water standards except for natural iron concentrations.

The principal aquifer in the area, the Pee Dee-Black Creek, aquifer—lies beneath the water table aquifer. All municipalities, as well as many small industries and naval bases, in the area draw their supplies from this aquifer. This water conforms to drinking water standards except for excess flouride and chloride content in several wells.

Almost all the recharge of the water table aquifer is from local precipitation. From there it moves to discharge points such as wells, streams, lakes, waterways and the ocean. Near areas of heavy pumping from the Pee Dee-Black Creek aquifer, water leaks slowly from the water table into the Pee Dee-Black Creek aquifer.

Salt water intrusion into the Pee Dee-Black Creek aquifer does not appear to be occurring.

5. HISTORICAL ARCHEOLOGICAL AND RECREATIONAL RESOURCES

(1) Historical Sites

The planning area contains several types of historical sites including plantation, historic churches and cemetaries, houses of architectural significance, and Revolutionary and Civil War sites. Several of these properties known as the Pawleys are included in the National Register of Historic Places. Hobcaw Barony and Arcadia Plantation are under review for nomination for inclusion in the National Register. Other sites within Brookgreen Gardens, but outside the 201 planning area, are pending National Register approval.

(2) Archeological Sites

There are several identified archeological sites in the vicinity of the proposed facilities. In designing the facilities, these sites were taken into consideration so that they are not in the path of any proposed transmission lines. Since detailed surface investigations have not been made for much of the land, the planning area contains other archeological sites.

(3) Recreational Resources

Natural areas such as the beach, ocean, bays, inlets and rivers, state parks and game management areas are popular recreational sites. Huntington State Beach Park, Myrtle Beach State Park, and municipal facilities supervise public uses of some of these sites. Golf courses and tennis facilities supplement the natural areas. Bathing, tennis, boating, fishing, camping, golfing, and hunting are the principal recreational activities.

6. COMMUNITY FACILITIES AND SERVICES

A combination of state, county and municipal agencies provide community services in the planning area. In general, state and county agencies provide health, welfare, educational, and highway services. The municipalities and counties share water supply, wastewater treatment, public safety, solid waste treatment, and administrative services. The major areas of community facilities and services in, or available to, the Grand Strand area are summarized below:

- Medical Services and Public Health. Two hospitals and a nursing center are located in Horry County but serve the general population in the two county area. The year round population contains 60 medical doctors and 20 dentists. The County Health Department is responsible for public health issues that include inspection of commercial kitchens, water supplies, dairies, and the installation of septic tanks, package plant systems and other waste disposal systems. The County Health Departments are agents of the State DHEC.

- Law Enforcement. Law enforcement activities are managed by a Sheriff at the county level and by a Chief of Police at the municipal level. Manpower is concentrated at the municipal level with a moderate amount of technical equipment support. The law forces utilize full and parttime staff to accommodate the peak season populations.

- Fire Protection. The municipal fire departments are staffed by both full time and volunteer firemen. Myrtle Beach has the largest number of firemen with 29 full time and 25 volunteers. It operated two stations and several types of equipment to meet the firefighting needs of high rise, high density development.

- Education. In addition to public schools, the area has technical education, college, and university facilities. The Horry-Georgetown Technical Education Center is a post high school facility offering many degrees. Although the goal of the Center is to assist adults in obtaining immediate employment, many of the degrees can be transferred to four-year college programs. The curricula are geared to attracting and assisting industrial firms in the area. The Coastal Carolina Regional Campus, of the University of South Carolina, located between Conway and Myrtle Beach, offers a variety of two and four-year programs.

- Transportation. While approximately 98 percent of all tourists arrive by car, the expansion of highway capacity has not kept pace with the area's growth. The major access roads are:

    - U.S. Route 17 which parallels the beach
    - U.S. Route 501 which connects Route 17 to Interstate 95 for access from the north
    - U.S. Route 378 which connects I-95 to Route 501 at Conway for access from the south
    - South Carolina Routes 9 and 917 which provide access to the northern end of the Grand Strand.

Access by air is provided at Myrtle Beach Airport (MBA), located next to the Intracoastal Waterway near Crescent Beach, and at Myrtle Beach Air Force Base (MBAFB). Commercial jet service to MBAFB was initiated in July 1975. MBA will be used increasingly for general aviation and should be expanded in the near future to meet increased service demands.

III. SUMMARY OF ALTERNATIVES ANALYSIS AND THE PROPOSED ACTION

1. USE OF SEPTIC TANKS AND PACKAGE PLANTS

The 201 facilities plan analysis of existing wastewater treatment facilities determined that five municipal plants plus several package plants were suitable for incorporation into the new plan. All other public, semipublic, and private plants should be phased out as soon as new regional facilities are available because of previously discussed water quality problems and potential health hazards.

2. EFFLUENT DISPOSAL AND ITS RELATION TO TREATMENT LEVEL

The two primary alternatives for disposal and/or reuse of wastewater treatment effluent were discharge to the Intracoastal Waterway and Waccamaw River, and spray irrigation with associated distribution systems. Computer results indicated that secondary treatment for discharges up to 6.0 mgd is adequate for disposal into the Waccamaw River below the confluence point with the Intracoastal Waterway. However, tertiary treatment is required for any discharge into the Intracoastal Waterway. It was also determined that secondary treatment is adequate for discharge of effluent from a single regional treatment facility, if the effluent is discharged through the Waccamaw River below the confluence with the Pee Dee River.

To determine the feasibility and the economics of applying effluents to the land, studies were conducted to determine soil characteristics in the study area, as well as anticipated effluent characteristics, percolation rates, and possible irrigation sites. It was concluded that because of a seasonal high water table in most soil types, land application could not be utilized on a year round basis. Therefore, in order to dispose of effluent on land, an alternative effluent disposal system would have to be used when the water table is high. Since a higher treatment plant standard would be needed to meet effluent requirements during this period, land disposal was rejected as a viable alternative.

3. COMPARISON OF WASTEWATER TREATMENT FACILITY ALTERNATIVES AND PLAN SELECTION

Because of the large area encompassed by the facilities plan, four regional wastewater treatment plant concepts were proposed as alternatives. Each of the regional plants' alternatives integrated various combinations of existing and usable wastewater treatment facilities. A total of 13 basic potential regional wastewater treatment plant configurations were identified for the four conceptual alternatives. These treatment alternatives were compared in terms of present worth and annual equivalent costs and the results are shown in (Table 4-7 from Chapter 4).

The initial analysis of the above 13 alternatives resulted in the selection of Alternative 9 as the proposed action. Alternative 9 involves the construction of three regional wastewater plants, A, C, and G, in addition to the continued use of the existing plants, MB-1, NMB-1, NMB-2, AF-1, and LB-1. All existing plants except MB-1 were to be phased out by 1982. However, as a condition of the November 21, 1975 approval of the Grand Strand facilities plan, the South Carolina Department of Health and Environmental Control required the analysis of seven additional alternatives affecting the north and central service areas. These seven alternatives are as follows:

- I - Discharge existing plant MB-1 and north plant A into the Intracoastal Waterway, with a treatment level of 10ppm BOD_5 and suspended solids, and 2ppm ammonia.

- II - Utilize existing plant MB-1 effluent for land spreading and discharge north plant A effluent into the Intracoastal Waterway with the same treatment as above.

- III - Utilize north plant A effluent for public land spreading and discharge existing plant MB-1 into the Intracoastal Waterway.

- IV - Utilize existing plant MB-1 effluent for land application and discharge north plant A effluent into the Intracoastal Waterway.

- V - Utilize north plant A for rural land application with 85 percent BOD_5 and SS removals, and discharge existing plant MB-1 into the Intracoastal Waterway.
- VI - Utilize existing MB-1 and north plant A for effluent rural land application.
- VII - Transfer the maximum practicable untreated effluent from the north plant A and existing plant MB-1 to the central plant G for discharge into the Waccamaw River.

A comparison of capital and annual O&M costs for these seven new alternatives is summarized in Table 4-13 in Chapter 4. This table indicates that alternative I which is essentially the same as Alternative 9 of the original 13 is the lowest in capital costs; Alternative V is the second lowest. Therefore, Alternatives I and V were considered further in the facilities plan supplementary engineering report. Given these two choices, Alternative I was selected because of the determination that a seasonally high water table throughout most of the area would preclude the land application of effluent on a large scale.

Table 5-1 presents the phasing of the proposed project and Figure 4-1 presents a map of the proposed system.

IV. PRINCIPAL FINDINGS AND CONCLUSIONS

1. WATER QUALITY

(1) Shellfish Areas

It can be expected that with one exception all closed shellfish areas can be opened as septic tanks and package plants are phased out, and as new central sewage plants are constructed. The one exception appears to be Winyah Bay, where preliminary analysis by the South Carolina Department of Health and Environmental Control indicated that the primary pollution sources are industrial. Resolution of this industrial point source problem will require further study.

(2) Intracoastal Waterway

Although considerable water quality modeling of the Intracoastal Waterway has been conducted, the validity of indicated results are still somewhat questionable because of the limited water quality data and utilization of a noncalibrated portion of the model. Nevertheless, it can be stated that some improvement in water quality in the Intracoastal Waterway can be expected as a result of the significant reductions of discharges from municipal wastewater treatment plants. It appears, however, that water quality criteria may not be achieved as a result of natural conditions in the waterway.

Figures IV-1 and IV-2 are water quality modeling results for the ICWW from Little River Inlet south, for wastewater effluent levels of 20 mg/l (BOD)/10 mg/l Ammonia 10 mg/l (BOD)/2 mg/l Ammonia, respectively. The latter level is proposed for the MB-1 and A plants as the best available treatment. Because the computer results portray actual dissolved oxygen levels for the July low flow condition, water quality standards may still be violated in the ICWW.

South Carolina statutes require that "new point source discharges must be designed to provide the highest and best degree of waste treatment practical under existing technology." The northern most plant, A and MB-1, will meet this requirement.

FIGURE IV-1

MYRTLE BEACH GRAND STRAND ICWW
JULY LOW FLOW DO PROFILE
PHASE I P.S., PROPOSED 20.10

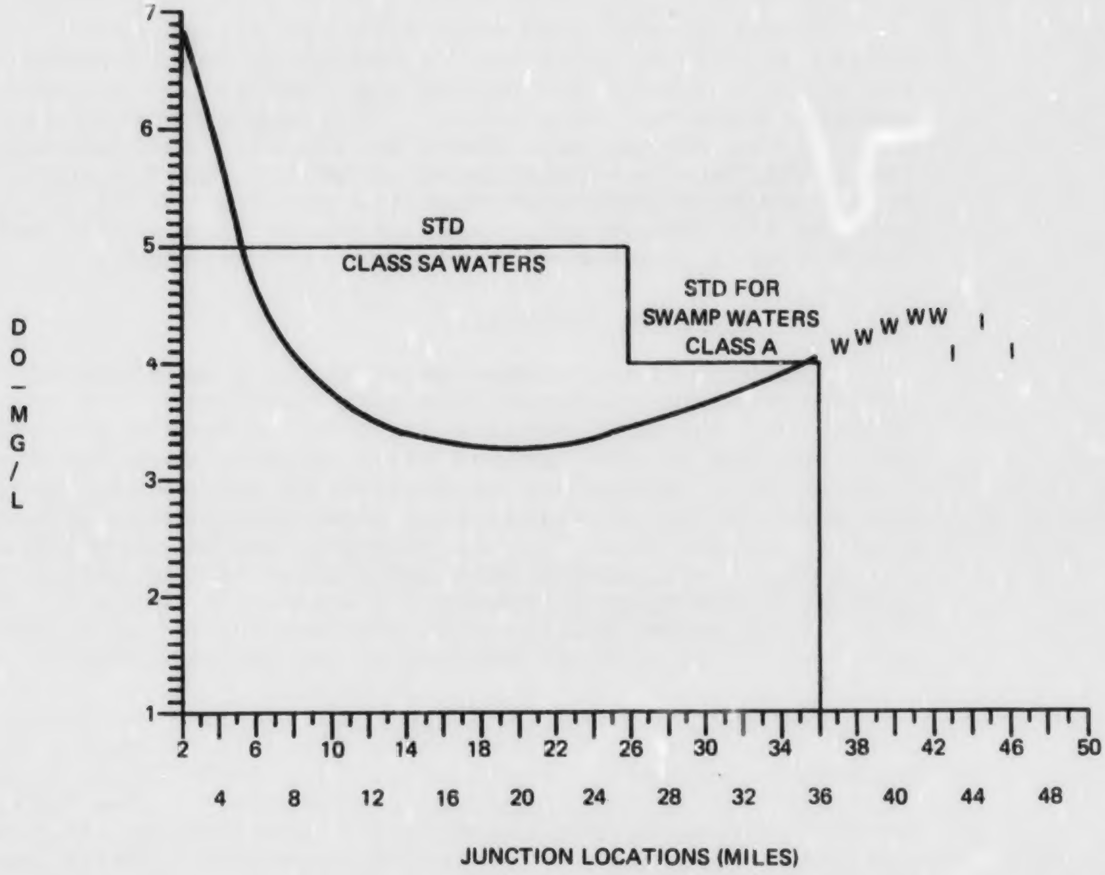
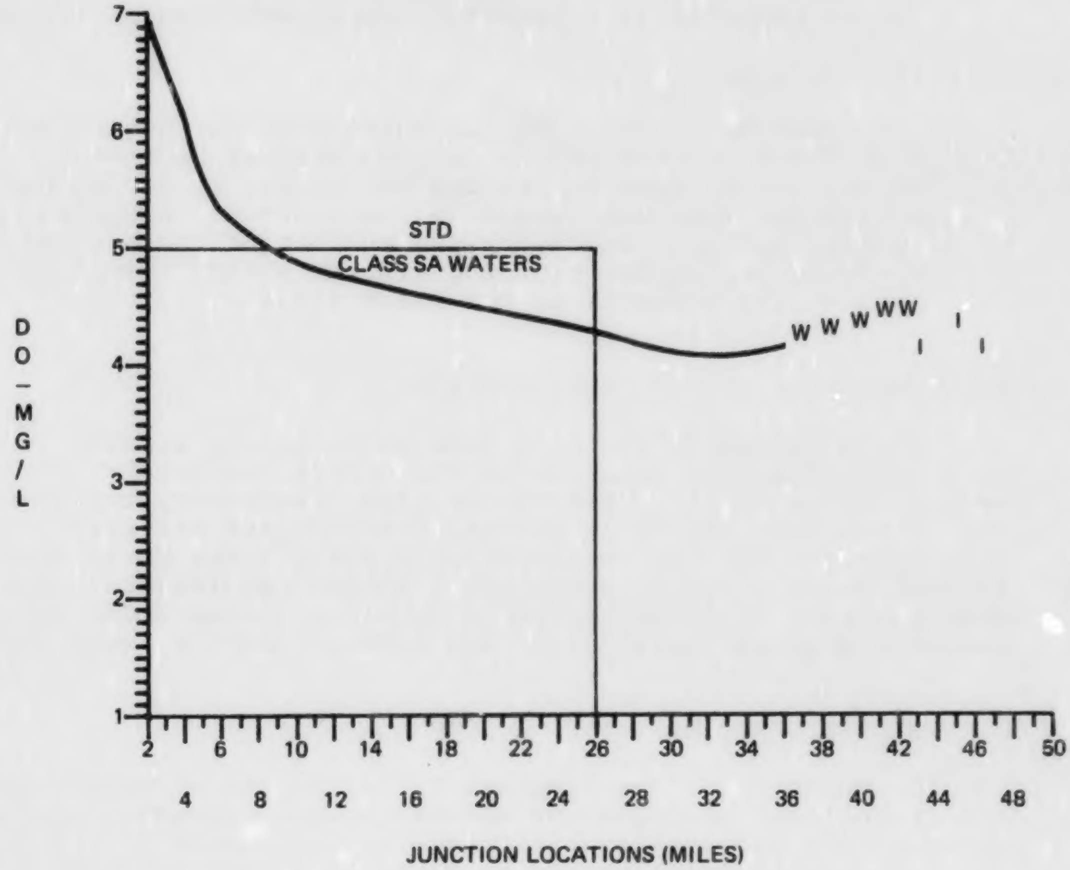


FIGURE IV-2

MYRTLE BEACH GRAND STRAND ICWW
JULY LOW FLOW DO PROFILE
PHASE I P.S., PROPOSED 10.2



(3) Waccamaw River

There is reason to believe that the River from Conway to a point about 1 mile below the confluence with the ICWW does not meet Class A standards. The most probable cause is the municipal discharge from Conway, which is outside the planning area. Improvements in the water quality below the confluence with the ICWW as can be expected as a result of implementation of the plan.

(4) Beaches

Beaches in the area currently meet the South Carolina State contact standards, and general bacterial levels can be expected to improve gradually as the new wastewater treatment plant is implemented. Nonpoint source controls, which are the subject of the current areawide wastewater planning effort, should result in further improvements to the beach areas.

2. TREATMENT SYSTEM CONFIGURATION

The final selection of a four-plant layout appears to be a cost-effective solution to the general wastewater treatment problems of the Grand Strand area. Secondary treatment in the two most southerly plants, C and G, and tertiary treatment for the two northernmost plants, A and MB-1, appear to meet South Carolina State point source regulations. Further analysis of effluent land disposal is recommended especially with the anticipated addition of many new golf courses.

3. SLUDGE DISPOSAL

In Phase I, sludge disposal by drying and offering the sludge to local golf courses appears sound. However, sludge volumes will increase significantly during Phases II and III; further consideration should be given to direct spraying of digested sludge and development of a sod farm and nursery utilizing liquid sludge, as proposed in the Facilities Plan.

4. SECONDARY IMPACTS RESULTING FROM GROWTH

(1) Impacts on Community Services From Population Growth Will be Similar Under the Proposed Action or the No Action Alternative.

Population growth will continue under either the proposed action or the no action alternative. The revision of WRPDC population estimates assume that ocean front property will be fully developed by 1990, that even at the revised projected growth rate the area will rapidly reach its density saturation, and that the high cost of land will deter the assemblage of land for high density uses. This growth will be sufficient to produce a demand for additional community services and facilities with specialized orientation according to the relative proportions of growth of the discrete populations in the area. Pressure on the transportation network should continue, as the existing highway capacity has not kept pace with area growth. A need for limited bus service may well emerge to serve both elderly and tourist populations.

(2) Significant Impacts to Community Services Will Result From Projected Growth

Few guidelines and standards exist which specify the level of services required in communities of different sizes. The requirements of each community will vary on the basis of its unique set of characteristics, of which size is only one. Communities can evaluate and project the adequacy and availability of services and facilities by considering:

- Population level
- Density
- Development patterns and land use
- Existing excess or deficiency of classroom, hospital and other facility capacity
- Population age characteristics
- Population income characteristics.

Specifically, for the population increase from current levels to those projected for 1997, significant increases in the requirements for the following community services can be expected:

- Schools
- Hospital beds
- Administrative facilities
- Police personnel and equipment
- Fire protection personnel and equipment
- Employment counseling
- Transportation.

(3) Impacts From the Pattern of Growth Will Vary Under the Proposed Action or No Action Alternative

The pattern of growth under the no action alternative will deemphasize industrial development. Industrial development will be less desirable, due to the more complex NPDES requirements and the high cost of package plants for industrial use. In addition, the no action alternative will tend to favor large-scale projects of either low density single-family residences or high density condominium and multi-family complexes. This is because septic tanks are only suitable for single-family homes on fairly large lots, due to poor soil conditions in the area. Moreover, the economics of scale for package plants are such that larger plants are more cost effective on a per unit basis and, thus, more marketable. Fewer but larger plants would also be more preferable for quality control and growth management purposes by local jurisdictions.

Under the proposed action, residential growth would continue in a similar fashion, however, there would be a greater flexibility in design and land use plans. Industrial growth would more likely be attracted by central municipal sewerage. Expanded industry would provide a broader, more balanced economic base for the Grand Strand area.

The mix of growth, residential, resort related, or manufacturing, might have an impact on the population median age and income level. Changes in these factors would influence demands on community services. An increase in the retirement age population may require additional health and welfare services; whereas an increase in the number of families with children due to expanded industrial employment opportunities would place demands on educational facilities. Income levels of the population will affect spending in the area, tax revenues, and, therefore, the availability of funds for expanding community services. Wages in the tourism industry are traditionally lower than other industries due to the seasonality and lower skill requirements of most tourism jobs.

(4) Under Either Alternative the Principal Concern Will be the Management of Growth

Since either alternative will result in continued growth, the principal objective of local authorities is to manage this growth in an orderly way and protect the area's natural resources and water quality. In recent years, both Horry and Georgetown counties have adopted zoning and subdivision regulations. Several of the municipalities have similiar regulations and have engaged in planning under HUD 701 grants and State of South Carolina grants. Under the no action alternative, growth management should be focused on developing stronger system standards and criteria for septic tank approvals; stringent design and inspection criteria for package plant systems; improved land use controls in the areas currently unzoned; and a process to systematically monitor plant effluent and management and septic tank malfunctions.

(5) Ecological Impacts of Growth

The projected growth and proposed plans for land development will impact natural vegetation and wildlife. It will deplete the habitats and food resources of Grand Strand wildlife. The wildlife will be limited in its ability to migrate successfully because other forests and vegetative areas have reached their carrying capacity.

5. COSTS

A breakdown of total capital costs for the project by steps in the grant application process under PL92-500 is shown below:

	EPA Share ($1000)	Local Share ($1000)	Total Capital Cost ($1000)
Step 1	165	55	220
Step 2	3,147	1,099	4,196
Step 3	55,225	18,409	73,634
	58,537	19,513	78,050

CHAPTER 1

BACKGROUND

This chapter presents an overview of the proposed regional wastewater facilities project for the Grand Strand area of Horry and Georgetown Counties in South Carolina. It is organized into the following sections:

1.1 Identification of Applicant
1.2 Objectives of Proposed Actions
1.3 Project Scope
1.4 Project History
1.5 Costs and Financing.

1.1 IDENTIFICATION OF APPLICANT

The Grand Strand Water and Sewer Authority is the lead applicant for the project which bears EPA Grants Administration Number C-450-381. This agency was established on June 2, 1971, to develop the regional wastewater facilities plan and to manage current and future wastewater programs. Its jurisdictional boundaries include all land between the Waccamaw River and the Atlantic Ocean in Horry County, South Carolina. The jurisdictional authority for the completed facilities would rest mainly with the Grand Strand Water and Sewer Authority. It would share this authority with the Georgetown County Water and Sewer District in the planning area in Georgetown County and with the incorporated municipalities in the Horry County portion of the planning area. These municipalities, which have complete authority within their respective service areas, are:

- North Myrtle Beach
- Myrtle Beach
- Surfside Beach
- Atlantic Beach.

These communities have agreed to have the Grand Strand Water and Sewer Authority serve as lead applicant for a 201 Facilities Plan grant application to the U.S. Environmental Protection Agency, and have approved that plan which is the subject of this EIS.

1.2 OBJECTIVES OF PROPOSED ACTION

The proposed regional wastewater facilities plan has as its main goal the provision for adequate treatment and disposal of the area's wastewaters. This goal is made up of short and long term objectives aimed at solving many of the area's environmental problems. These objectives include:

- Elimination of the public health risk of existing treatment facilities
- Opening of closed shellfish areas and enhancement of wetlands
- Elimination, ultimately, of wastewater pollution sources and discharges which violate acceptable ground and surface water standards
- Conservation of existing and future potable water supplies, energy supplies, and material resources of the region
- Recharging of groundwater to augment potable water supply
- Reuse of treated wastewater, recycling of nutrients in treated wastewater (spray irrigation), and recycling of nutrients recovered from wastewater (sludge application to land) where practical
- Preservation and enhancement of existing high quality surface waters
- Enhancement of existing and planned recreational areas through provision of adequate wastewater disposal.

The facilities plan was designed to meet these goals.

1.2.1 Areawide Surface Water Quality Problems

The quality of the surface water of the Grand Strand area has been degraded by wastewater management practices which have been inadequate and which have failed to keep pace with the growth of the region. The most serious impact on surface waters has been to the Intracoastal

Waterway, the Waccamaw River, and the wetlands— shellfishing areas including parts of Winyah Bay, Murrell's Inlet, Pawley's Island, Litchfield Beach, Little River, and Cherry Grove Inlet. The waters of the Intracoastal Waterway are slow-moving and cannot accommodate the relatively large sewage loads which have been discharged into the waterway. The result has been serious pollution of the waterway and its recipient water bodies, the Waccamaw River, the Little River, and the Little River Inlet.

The beaches have suffered some contamination as well, mostly from discharges of inadequate wastewater facilities at campgrounds and from urban runoff to creeks and swashes which flow into the ocean. These discharges into the ocean are most severe during periods of heavy rainfall. According to the South Carolina Department of Health and Environmental Control, streams and marshes in the region have also been contaminated, as a result of:

- Septic tank discharges which remain close to the surface and contaminate runoff
- Poor quality effluents from community treatment systems
- Industrial wastewater discharges.

Much work has already been done to attack the area's surface water quality problems, including the following:

- Several new municipal treatment plants have been built which will discharge high quality effluents.
- Industrial wastewater treatment facilities are being upgraded.
- Permits for new package-type treatment plants and septic systems have been issued with the contingency that future hookup to a regional treatment system is required.
- A program of providing qualified treatment plant operators to public and private systems as well as a program of improved plant performance testing and monitoring, are underway by the Grand Strand Water and Sewer Authority.

- Modeling of the waters of the Intracoastal Waterway and the North Inlet has been done to better understand the water quality problems in these bodies.

- The South Carolina Department of Health and Environmental Control (DHEC) has limited the proliferation of package-type treatment systems to outfall locations which are compatible with waste load allocations.

- Some new development projects have been denied package plant permits by DHEC on the grounds that water quality standards would be violated.

- DHEC has encouraged sub-regional development of wastewater treatment systems or tie-ins to existing facilities to limit the construction of new package plants. An interceptor, the "Environs Line," was recently constructed to link several new developments to central municipal treatment facilities.

The existing regional treatment system, which consists of five municipal plants, the Myrtle Beach Air Force Base plant, approximately sixty package plants, three industrial wastewater treatment plants, thousands of septic systems, and numerous sewage lagoons, is physically and institutionally unmanageable. The basic needs for improvement of this system result from:

- Inadequate treatment capability

- Inadequate treatment capacity in some cases

- Lack of daily supervision of plant operations and maintenance needs

- Overflows of treatment systems and lagoons in wet weather

- Inadequate percolation of septic tank effluents due to soil conditions.

Even if full enforcement of all permits, laws, regulations, and ordinances were accomplished, the physical limitations of the fragmented regional system would pose continued serious threats to the water quality of the region.

1.2.2 Areawide Groundwater Quality and Quantity Problems

The increase in potable water consumption resulting from continuous growth of the region has significantly drawn down the water table in the deep artesian aquifers of the region. Sufficient quantities of groundwater exist in the area to supply the region with potable water for many years. However, proper location and construction of wells is necessary to avoid excessive drawdowns.

The quality of the groundwater in the region meets U.S. Public Health Service drinking water standards except, in some cases, when the standard allowances for fluorides, iron, and chlorides are exceeded. The potential exists for contamination of groundwater by surface pollutants. Pollutants from sources such as septic system discharges and seepage from sewage lagoons and contaminated creeks and streams can be carried to the water table aquifer by rainwater and percolation of discharges. While relatively little use is made of the water table aquifer for potable water supplies, this aquifer does leak into the main water supply aquifer, the Pee Dee-Black Creek aquifer. The existing regional wastewater treatment and disposal system poses a threat to the quality of the groundwater potable water supply of the region because of its current contamination of the water table aquifer.

1.2.3 Plans for Attainment of Water Quality Standards and Retention of Areas of Superior Water Quality

The attainment of surface water quality standards is expected to be accomplished through continued efforts such as those described in Section 1.2.1 and through implementation of the regional plan; the subject of this EIS. The contribution to surface water pollution from non-point sources such as urban and agricultural run-off will be addressed by the areawide 208 planning process now underway by the Waccamaw Regional Planning and Development Council (WRPDC).

Groundwater quality standards and drinking water quality standards are expected to be met by a more scientific and better-managed program of well location, construction, and improvement. Information necessary to design this program is currently being gathered in a joint project by the U.S.G.S. and the South Carolina Water Resources Commission.

Perhaps the region's most important water resources for superior water quality are sections of the Waccamaw River. Except for that portion of the river which extends from Conway to a point approximately one mile below the confluence with the Intracoastal Waterway, the river meets water quality standards. Other water resources of superior quality are freshwater marshes which adjoin the clear sections of the Waccamaw, many streams and creeks in undeveloped and rural areas, and several ponds north of the Dunes Club area between Highway 17 and the ocean. Both the proposed 201 facilities plan and the recently initiated 208 planning process will serve to enhance the quality of these resources.

1.3 PROJECT SCOPE

The proposed wastewater facilities plan covers a large territory of approximately 400 square miles. This area includes all the land between the Waccamaw River and the Atlantic Ocean in Horry and Georgetown Counties, South Carolina. A general location map is provided in Figure 1-1.

The planning area has been divided into three separate service areas accommodating the three regional treatment plants which comprise the final plan. These service areas are shown in Figure 1-2.

Area 1 in Horry County is the center of tourism in the planning area. It experiences the highest seasonal fluctuations in population which translate into peak sewage flows of up to eight times the flows from the permanent population. Existing development is concentrated in a 1-mile strip along the ocean, with a mix of residential, commercial, and recreational land uses—predominantly golf courses and campgrounds.

In contrast to Area 1, Area 2 in Georgetown County has large flood plain areas which have served to insulate the area from growth and which are currently devoted to open space. This area is also affected by tourism with peak tourist season sewage flows estimated at six times the flows from the permanent population.

Area 3 is largely undeveloped at present, but has commercial and institutional development along U.S. Route 501 and residential development along Route 90 between Nixon's Crossroads and Little River. A planned development of 40,000 acres within this area by International Paper Realty Company could significantly change the character of the Grand Strand. Development within this large tract is anticipated in the proposed facilities plan.

FIGURE 1-1
General Location Map

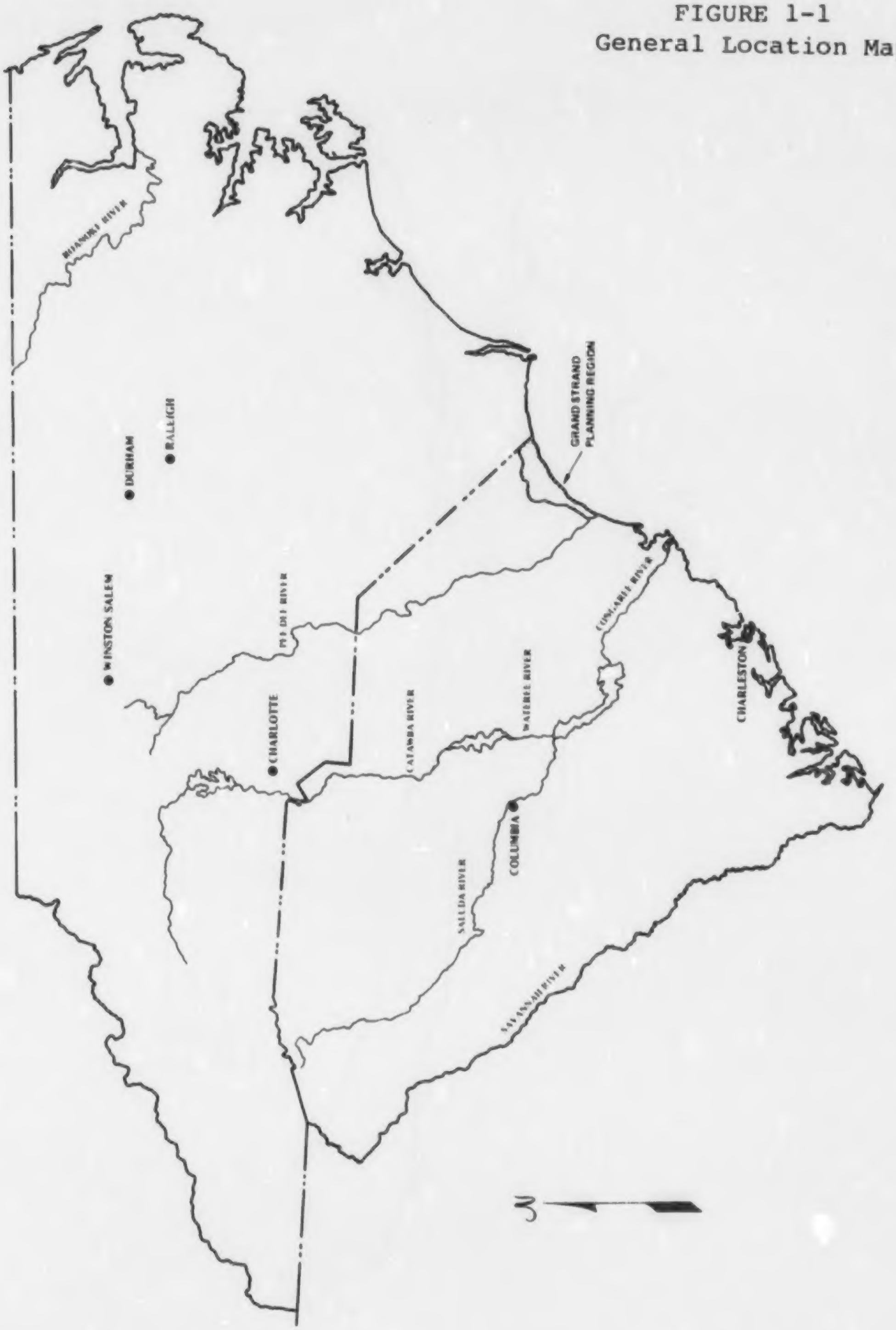
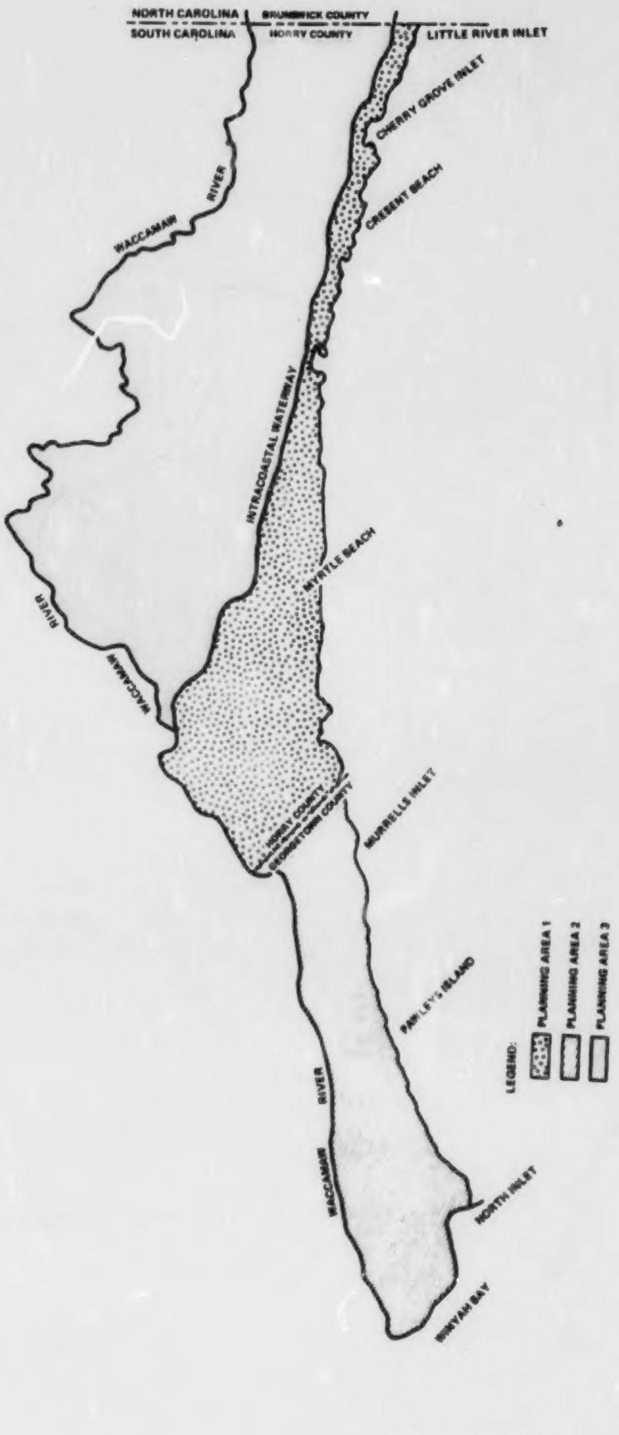

ROANOKE RIVER
RALEIGH
DURHAM
WINSTON SALEM
PEE DEE RIVER
CHARLOTTE
CATAWBA RIVER
WATEREE RIVER
CONGAREE RIVER
GRAND STRAND
PLANNING REGION
CHARLESTON
COLUMBIA
SALUDA RIVER
SAVANNAH RIVER
N

FIGURE 1-2
Map of Planning Area


NORTH CAROLINA
SOUTH CAROLINA
BRUNSWICK COUNTY
HORRY COUNTY
LITTLE RIVER INLET
CHERRY GROVE INLET
CRESENT BEACH
WACCAMAW RIVER
INTRACOASTAL WATERWAY
MYRTLE BEACH
WACCAMAW RIVER
HORRY COUNTY
GEORGETOWN COUNTY
MURRELLS INLET
PAWLEYS ISLAND
WACCAMAW RIVER
NORTH INLET
WINYAH BAY
LEGEND:
▨ PLANNING AREA 1
☐ PLANNING AREA 2
☐ PLANNING AREA 3

1.3.1 Proposed Facilities

The proposed facilities for all three service areas have the following features in common:

- Secondary treatment of wastewater for most plants, with tertiary treatment for facilities discharging to the Intracoastal Waterway
- Flow equalization or modular treatment units to accommodate high seasonal flows
- Project phasing to allow for use of acceptable existing plants as much as possible
- Sludge disposal initially by use of sludge drying beds, with later consideration to be given to land application
- Extensive use of pressure transmission systems which use networks of pumping stations rather than gravity to provide energy for wastewater flow
- Location of transmission lines for most of their length along roadway rights of way
- Phasing of construction to meet wastewater treatment demand according to expected patterns of growth.

Figure 4-1 shows the location of the proposed facilities.

Service Area 3 will use a somewhat more complex system than the other two service areas as a result of the requirement for tertiary treatment of effluent discharged to the Intracoastal Waterway. The regional treatment plant in the area will occupy a 72-acre site across the Intracoastal Waterway from the Myrtle Beach Airport.

The treatment plant for Service Area 1 will bear the burden of the highest seasonal wastewater flows. It will be located on a 25-acre site near Route 544 southwest of Socastee. Its effluent will be discharged to a point on the Waccamaw River, downstream from the confluence with the Intracoastal Waterway.

Service Area 2 will use the smallest of the three regional systems. Plans call for initial use of the existing treatment plant, followed by construction of a new plant at the same site after the expansion of the site from 1.1 acres to 11.1 acres.

1.3.2 Nonstructural Actions of the Project

Perhaps the most important nonstructural actions of the project are those which have gone into the plan already, in the form of coordination with other planning agencies. Compatibility of the Grand Strand wastewater facilities plan with the plans of neighboring communities was achieved through coordination of the:

- Horry County Water and Sewer Authority
- Georgetown County Water and Sewer District
- Waccamaw Regional Planning and Development Council.

The boundaries of the planning area were determined through the joint efforts of the Waccamaw Regional Planning and Development Council and the South Carolina Department of Health and Environmental Control. The proposed plan incorporated the WRPDC's land use plan, as well as its population and economic studies.

An important institutional arrangement is recommended by the plan: the contracting of the Grand Strand Water and Sewer Authority by the Georgetown Water and Sewer District for wastewater treatment service in the area of Georgetown County, north of Brookgreen Gardens and Huntington State Park. In this area the Georgetown Water and Sewer District will retain complete authority for wastewater collection and transmission.

The plan also proposes that the Grand Strand Water and Sewer Authority purchase those existing treatment facilities which will be incorporated into the regional plan, namely:

- Myrtle Beach Plant MB-1
- North Myrtle Beach Plants NMB-1 and NMB-2
- Myrtle Beach Environs Sewer System.

Ownership of these plants by the Authority is recommended in order to:

- Develop a complete staff of fully qualified wastewater treatment plant operators under single agency control

- Provide the necessary flexibility in operation during an emergency or during unusual flow or loading conditions

- Establish single responsibility and control of systems, costs, and revenues to enhance project funding.

Another proposed action involves the disposition of the existing wastewater facilities, both public and private, which will be phased out by the plan. Some of the better quality facilities will be retained through one or two stages of the project and then phased out. The plan calls for the Grand Strand Water and Sewer Authority to assist in inspecting, cataloging, and marketing any of the equipment of the phased out facilities which might be put up for sale.

The plan has been augmented by a study of revenue generation entitled "Comprehensive Wastewater Rate Analysis."* This study determined a user charge system for the project and proposed the issuance of revenue bonds to finance the local share of the project cost. This study also recommended that the existing industrial dischargers pretreat their wastes to meet a domestic sewage classification before being connected with the proposed regional system. New industrial users of the proposed system would be subject to industrial cost recovery and surcharge programs which would be developed by the Grand Strand Water and Sewer Authority.

No new laws, regulations, or ordinances would be required to implement the proposed plan.

1.4 PROJECT HISTORY

The development of the "Master Plan of Wastewater Facilities for the Grand Strand Region" is described in this section. It discusses project history from the creation of the Grand Strand Water and Sewer Authority in June 1971, to the initiation of the environmental impact statement in July 1975.

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* Prepared for Grand Strand Water and Sewer Authority by Black, Crow, and Eidsness, Inc.

1.4.1 Creation of the Grand Strand Water and Sewer Authority

In response to the great pollution of the area's waters and the inadequacies of the fragmented wastewater management system in dealing with existing and projected water quality problems, the Grand Strand Water and Sewer Authority was created on June 2, 1971. The Authority initiated the 201 wastewater treatment facilities planning process, selected the consulting firm Black, Crow, and Eidsness to develop the plan, and contributed much of the background information used to develop the plan.

1.4.2 Development of the Plan

Work on the plan began in January 1974, and a draft plan was made available for public review on May 25, 1974. Important events which occurred during the planning process are discussed briefly below:

- The planning area was increased from that area in Georgetown and Horry Counties, South Carolina east of the Waccamaw River and Intracoastal Waterway to all areas in Georgetown and Horry Counties east of the Waccamaw River. This action approximately doubled the size of the planning area.
- A new land use plan was developed by WRPDC to correspond to the increase in planning area size.
- A survey of existing wastewater treatment facilities revealed a much greater number of facilities than was previously known to exist.
- The proposed Myrtle Beach Environs Sewer System plan was revised to make it compatible with the 201 Master Plan. The environmental impact statement for this project was deferred so that the Environs System would be treated in the 201 plan EIS.

1.4.3 Public Participation

Early in the development of the plan, public representatives of local communities were appointed to participate in the process. Several meetings were held with the representatives, including meetings just prior to the public hearings. Notice of public hearings was given three weeks in advance, and opportunity for public review of the grant application, environmental assessment, and 201 Master Plan was provided for two weeks prior to the public hearings. Two public hearings were held: one for the draft plan, on June 10, 1974, and one for the final plan, on January 18, 1975. At the first hearing, several questions were raised by the public and addressed by the consultants as follows:

> Question 1: What areas will be served first and how can the municipalities plan to meet the transmission system with appropriate collection systems?
>
> Answer: Meetings will be needed between the GSWSA and municipalities to work out the details of collection. The rate study will provide foundation for contracts between GSWSA and municipalities.
>
> Question 2: What is the role of the existing Litchfield treatment plant in the proposed regional system?
>
> Answer: The existing Litchfield treatment plant will be part of the regional system until 1980 when it will be phased out and replaced.
>
> Question 3: Can existing treatment facilities at Myrtle Beach be upgraded in order to protect investments in those facilities?
>
> Answer: Existing facilities at Myrtle Beach cannot be upgraded satisfactorily, and any such attempts at upgrading would not be cost-effective and would result in conflicts with land use and the zero discharge goal of PL 92-500.
>
> Question 4: Is land disposal of effluent possible in the North Myrtle Beach area where the city owns large tracts of land?
>
> Answer: All suitable land disposal sites are or have been investigated, indicating that golf courses and highway median strips are the most suitable areas for spray irrigation of treated effluent.

Question 5: Are existing population projections adequate? (Written comment submitted by Georgetown Water and Sewer District)

Answer: Review and updates of existing population projections are underway by WRPDC.

Question 6: Why are certain costs of the recommended three-plant system higher than those of the alternative two-plant systems?

Answer: The 20-inch diameter pressure sewer from Highway 17 to Plant C in the three-plant system accounts for most of the difference in transmission line length and cost. Cost of lift stations in the three-plant system is somewhat higher than cost of those for the two-plant system.

1.4.4 Initiation of 201 Plan EIS

The Region IV EPA office, in Atlanta, Georgia, made the finding that an environmental impact statement for the plan was necessary for the following reasons:

- An EIS for the Environs System was found necessary and had been deferred.
- Future growth of the planning area, and its potential impact on the natural and manmade environment was not well understood.
- The pollution assimilation capacity of the planning area was not well understood.

Booz, Allen & Hamilton, Inc., was selected to prepare an EIS draft and began work in July, 1975.

1.5 COSTS AND FINANCING

Those costs eligible for Federal grant are the administrative, engineering, and contingency costs accrued by the Grand Strand Water and Sewer Authority in undertaking the 201 planning process as well as the costs of construction of the proposed interceptors and treatment plants. The costs of acquiring and upgrading existing facilities, and of acquiring the sites of the proposed wastewater treatment plants are not eligible for grants.* A breakdown of total capital costs for the project by steps in the grant application process under PL 92-500 and according to EPA share and local share is shown below:

	EPA Share ($1000)	Local Share ($1000)	Total Capital Cost ($1000)
Step 1	165	55	220
Step 2	3,147	1,099	4,196
Step 3	55,225	18,409	73,634
	58,537	19,513	78,050

Financing for the local share of the total cost is expected to come from the issue of revenue bonds by the Grand Strand Water and Sewer Authority for those facilities in Horry County and from the Georgetown Water and Sewer District for those facilities in Georgetown County.

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* "Comprehensive Wastewater Rate Analysis," April 1975.

CHAPTER 2

EXISTING NATURAL ENVIRONMENT

The 400-square mile planning region for the proposed Grand Strand wastewater facilities consists of approximately 380 square miles of relatively flat land area and 20 square miles of surface water area. The planning region is geographically located between 34°00' and 33°46' North Latitude and 78°34' and 79°16' West Longitude, which includes all areas between the Atlantic Ocean and the Waccamaw River in Horry and Georgetown Counties, South Carolina.

The Grand Strand region presently has good ambient air quality and a rich, diverse biological environment. As a result, the region has been designated by the U.S. EPA as a Class III (see Appendix A, Section 2.0) air quality deterioration area, which is the least restrictive air quality degradation class or category. The region has attracted over 200 species of birds, 100 species of wildlife, and 120 species of aquatic life. However, ground and surface water quality is poor because of wastewater effluent contraventions. Existing oxidation ponds, septic tanks, and package treatment plants are the primary point sources of pollutant emissions which have resulted in the closing of shellfishing areas and contamination of the water table aquifer. Ten municipal, 58 private, and 3 industrial waste treatment plants, along with the many septic tank units, are the dominant sources of degradation of water quality.

The natural environment of the Grand Strand region has many physical, chemical, and biological features which may be affected by the proposed wastewater treatment facilities. To provide the necessary baseline for assessing primary and/or secondary impacts, this chapter describes the existing natural environment of the Grand Strand planning region under the following matrix headings:

- Surface Water
- Ground Water
- Water-Land Interface Areas
- Land
- Atmosphere
- Sensitive Natural Areas.

2.1 SURFACE WATER

The Grand Strand planning region is drained by several natural streams or rivers and man-made waterways.

The major natural water system draining the area is the Waccamaw River which flows southeasterly from the North Carolina border to Winyah Bay, which empties into the Atlantic Ocean. In addition, the planning region is drained by many small coastal streams and the man-made Intracoastal Waterway which was created by dredging the Little River.

2.1.1 Water Quality and Quantity

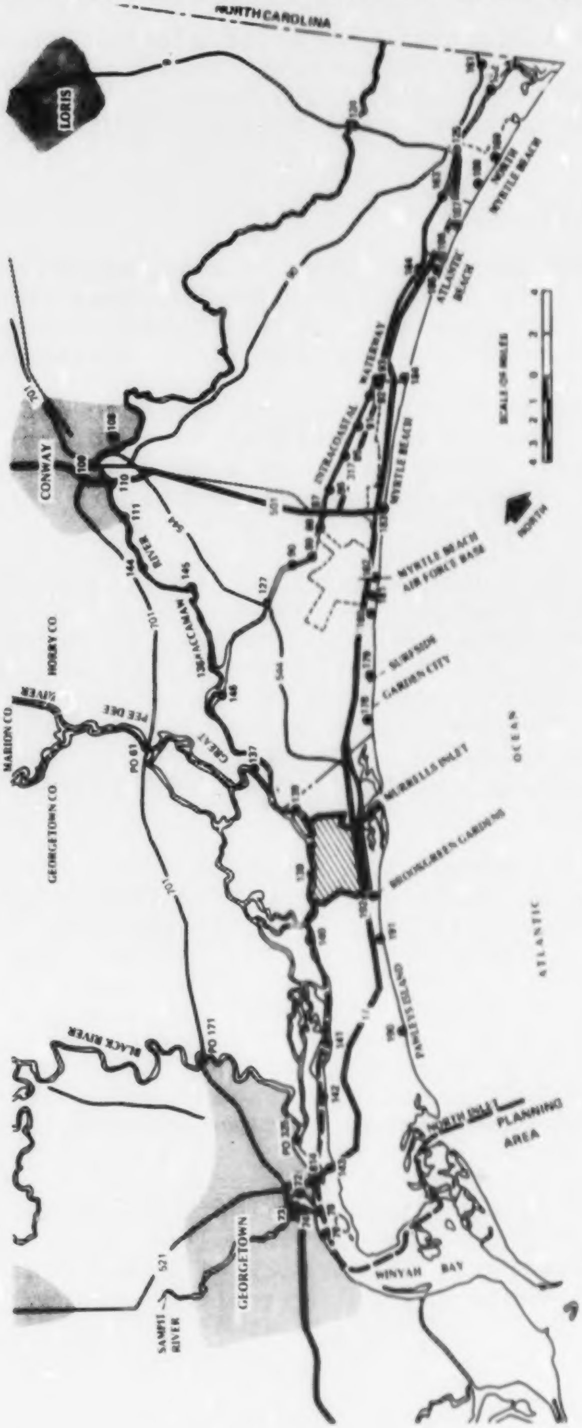
As a result of permanent and transient population increases in the Grand Strand area, the use of package sewage treatment plants and septic tanks has proliferated and water quality problems have become more severe in recent years. A water quality sampling program was initiated in 1971 by the South Carolina Department of Health and Environmental Control (DHEC). Figure 2-1 shows the sampling stations established by the DHEC along the Waccamaw River and Intracoastal Waterway.

In 1970, the State of South Carolina promulgated water classification standards for the State's freshwater and tidal saltwater systems. These standards defined different water usage classes and water quality specifications for each class. Figure 2-1 indicates the class of each water system associated with the planning region, as established by the State.

The designation for the Waccamaw River from the North Carolina border to the confluence of Bull Creek is Class A in which the water quality should be suitable for swimming and other body contact recreation. The Waccamaw, from the North Carolina border to the City of Conway, is considered swamp waters and is permitted a 1 mg/l lower dissolved oxygen and a 1 pH unit lower acidity level than the freshwater Class A standards. Winyah Bay, from the ocean to where Route 17 crosses the river, has been designated as Class SC and is, therefore, suitable for crabbing, commercial fishing and any other usages except bathing or other shellfishing for market purposes. The Intracoastal Waterway has been designated as Class A from its confluence with the Waccamaw River to a point where the chloride concentration is above 250 mg/l (which is approximately at the location where Route 17 crosses the Waterway). From Route 17 to the ocean, the Waterway is classified as SA. The classification for all the beach waters and estuaries between Winyah Bay and Little River Inlet is also Class SA.

FIGURE 2-1

Water Quality Sampling Locations Along Waccamaw River and Intracoastal Waterway and Water Quality Classifications


NORTH CAROLINA
LORIS
NORTH MYRTLE BEACH
ATLANTIC BEACH
INTRACOASTAL WATERWAY
MYRTLE BEACH
SCALE OF MILES
NORTH
MYRTLE BEACH AIR FORCE BASE
CONWAY
WACCAMAW RIVER
HORRY CO
MARION CO
GEORGETOWN CO
PEE DEE RIVER
GREAT
SURFSIDE
GARDEN CITY
MURRELLS INLET
BROOKGREEN GARDENS
ATLANTIC OCEAN
PAWLEYS ISLAND
BLACK RIVER
NORTH INLET
PLANNING AREA
WINYAH BAY
GEORGETOWN
SAMPIT RIVER

The following sections discuss the water quality and quantity of the major water systems in the Grand Strand. The water quality results presented in the discussion are based on the data obtained from the DHEC sampling program.

2.1.2 Waccamaw

The Waccamaw River is a relatively small coastal river which originates from Lake Waccamaw, North Carolina. The river flows generally in a southeasterly direction for about 140 miles before emptying into Winyah Bay.

The topographic characteristic along the river is essentially level with a fall of only 40 feet while en route to Winyah Bay. River water is a dark almost black color as a result of decomposing organic matter in the flat river swamps.

Lake Waccamaw complete in 1943 is formed by a 205 foot long concrete dam and has a crest elevation of 42 feet mean sea level (MSL). The Lake is owned and operated by the State of North Carolina Park System and has three flood gates that are approximately 3 feet by 4 feet each. The purpose of these gates is to maintain the level of the lake and the effect of this operation on the flow of the Waccamaw River is slight, providing the lake is kept at a constant level.

The flow of the Waccamaw River has been monitored for the past 24 years by the United States Geological Survey (USGS). A high flow of 11,100 cu. ft./sec. was recorded on July 6, 1961, and a low of 1 cu. ft./sec. was recorded on October 14, 1954. The average flow, based on using the 24-year data is 1,205 cu. ft./sec. The low flow periods for the Waccamaw during an average year are May-June and November-December and the seven day-ten year low flow rate is 3.7 cu. ft./sec. These flow rates represent the recorded values of the USGS gaging station located near Longs, South Carolina.

Pollutant contraventions of the Waccamaw River to date have included only the dissolved oxygen and fecal coliform parameters. A summary of these contraventions is presented in Table 2-1 for dissolved oxygen, and Table 2-2

Table 2-1
Waccamaw River
Summary of Dissolved Oxygen Contraventions

Sampling Station	Year				
	1970	1971	1972	1973	1974
MD 124*	N.O.	N.O.	—	—	—
MD 108*	—	—	—	—	N.O.
MD 109*	—	—	—	—	Aug.(2)**
MD 110	—	July,Sept.	June,Sept.	Aug.,Oct.	N.O.
MD 111	—	July,Sept.	June,Sept.	Aug.,Oct.	Aug.,(2)** Sept.
MD 144	—	N.O.	—	Aug.,Oct.	N.O.
MD 145	Oct.	N.O.	—	Aug.,Oct.	N.O.
MD 136	Oct.	N.O.	July,Sept.	Aug.,Oct.	Aug.
MD 146	Oct.(2)*	N.O.	July	Aug.,Oct.	Aug.
MD 137	N.O.	N.O.	July	Aug.,Oct.	—
MD 138	N.O.	N.O.	—	Oct.	June,Aug.
MD 139	N.O.	N.O.	July	—	June,Aug.
MD 140	N.O.	N.O.	July	—	June,Aug.
MD 141	N.O.	N.O.	July	—	June,Aug.
MD 142	N.O.	N.O.	July	—	June
MD 143	N.O.	N.O.	July	—	Aug.

N.O. No Observation

* Classified as swamp water A.

** Number of times contraventions occured each month are shown in parentheses (if greater than 1).

Table 2-2
Waccamaw River
Summary of Fecal Coliform Contraventions

Sampling Station	Year				
	1970	1971	1972	1973	1974
MD 124*	N.O.	—	—	June	Aug.,Oct.
MD 108*	—	—	May	—	N.O.
MD 109*	—	—	June,Sept.	Aug.	May
MD 110	—	—	June,July,Sept.	May,Aug.	N.O.
MD 111	June	—	May,June,July	May,Aug.	May,June, July,Oct.
MD 144	N.O.	N.O.	—	May	N.O.
MD 145	N.O.	N.O.	—	July	N.O.
MD 136	N.O.	N.O.	—	—	—
MD 146	N.O.	N.O.	—	—	—
MD 137	Although specific data on sampling was not provided, no contraventions occurred during this period.				
MD 138					
MD 139					
MD 140					
MD 141					
MD 142					
MD 143					

N.O. No Observation

* Classified as swamp water A.

for fecal coliform. These tables provide dates and locations of the contraventions and are based on DHEC data. The dissolved oxygen violations have ranged from 4.9 mg/l to 0.3 mg/l at various times and locations. For fecal coliform, the violations have ranged from 430 counts MPN (Most Probable Number)/ 100 ml to 31,000 MPN/100 ml. The Class A standards for dissolved oxygen and fecal coliform are 5 mg/l and 200 MPN/100 ml, respectively.

The reach of the Waccamaw River upstream of Conway to the North Carolina border meets water quality standards for dissolved oxygen with occasional contraventions of fecal coliform criteria (sampling stations MD 108 to MD 124). However, downstream of Conway to the Route 17 bridge, dissolved oxygen contraventions occur at each sampling location during the summer months. Violation of fecal coliform criteria downstream of Conway has occurred at sampling stations for only a short distance downstream of Conway (MD 109 to MD 145).

2.1.3 Intracoastal Waterway

The Atlantic Intracoastal Waterway was constructed by the U.S. Army Corps of Engineers during the 1930's for the purpose of providing a protected channel for water-based freight and transportation. The Corps is presently responsible for maintaining the 90-foot wide by 12-foot deep channel.

The flow characteristics of the Intracoastal Waterway between Enterprise Landing and Little River Inlet are primarily dependent upon the flow volumes of both the Waccamaw River and the Great Pee Dee River in addition to tidal fluctuations of the Atlantic Ocean. The Waterway flow is predominantly influenced by the Waccamaw River during periods of high discharge.

During low flood periods, however, the Pee Dee River is thought to have the major influence on the characteristics of the Intracoastal Waterway. As a result, the net direction of flow changes from south to north from Enterprise Landing to the North Carolina boundary. A precise determination of the Intracoastal Waterway flow characteristics is difficult and complex because of these factors.

For the Waccamaw River two parameters violate water quality standards—dissolved oxygen and fecal coliform. Tables 2-3 and 2-4 summarize the dissolved oxygen and fecal coliform contraventions, respectively. Violations of water quality standards for both fecal coliform and dissolved oxygen have occurred during the summer months in the Intracoastal Waterway from its confluence with the Waccamaw River to the Atlantic Ocean at Little River.

2.1.4 Beach Waters

A limited study of bacterial quality of beach water in Myrtle Beach and North Myrtle Beach was conducted by the Environmental Protection Agency from August 30 to September 3, 1972. Samples were initially collected during low tide conditions from 23 storm sewers or swashes. Eight surf stations were then analyzed for fecal and total coliform bacteria.

The bacterial quality of the majority of the surf samples were within the recommended South Carolina standards for primary contact recreation (geometric mean of not more than 200 fecal coliform/100 ml, or 400 fecal coliform/100 ml in more than 10 percent of the total samples in a 30 day period). However, under the Class SA criteria for the coastal waters, the U.S. Public Health Service Shellfish Standards are in effect. These standards require that the total coliform bacterial not exceed a median MPN of 70/100 ml. Furthermore, not more than 10 percent of the samples shall exceed an MPN of 230/100 ml in those areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions.

Approximately half of the stations sampled were in violation of the Class SA standard. In addition, the EPA study found that the bacterial counts measured at some of the surf stations were affected by rainfall. Total and fecal coliform densities of 2,300 MPN and 1,300 MPN/100 ml, respectively, were measured at Station 35 during a rainfall period. Some of the main sources of bacterial pollution were believed to be caused by streams flowing through septic

Table 2-3
Intracoastal Waterway
Summary of Dissolved Oxygen Contraventions

Sampling Station	Year				
	1970	1971	1972	1973	1974
MD 127	Oct.(2)**	N.O.	July	Aug.	Aug.
MD 90	Oct.(2)**	N.O.	—	Aug.	N.O.
MD 89	Oct.(2)**	N.O.	July	Aug.,Oct.	Aug.
MD 88	Oct.(2)**	N.O.	July	Aug.	Aug.
MD 87	Oct.(2)**	N.O.	Sept.	Aug.(2)**	Aug.
MD 86	Oct.(2)**	N.O.	Sept.	Aug.	N.O.
MD 85	Oct.(2)**	N.O.	Sept.	Aug.	—
MD 91	Oct.(2)**	N.O.	Sept.	Aug.	Aug.
MD 92	Oct.(2)**	N.O.	Sept.	Aug.	N.O.
MD 93	Oct.(2)**	N.O.	Sept.	Aug.	N.O.
MD 164	N.O.	N.O.	Sept.	—	N.O.
MD 163	N.O.	N.O.	Sept.	—	N.O.
MD 125*	N.O.	N.O.	Sept.	—	—
MD 162*	N.O.	N.O.	Sept.	—	—
MD 161*	N.O.	N.O.	—	(1)	May,Oct

N.O. No Observation

* Classified as SA

(1) Contravention occurred but date is unknown.

** Number of times contraventions occurred each month are shown in parentheses (if greater than 1).

Table 2-4
Intracoastal Waterway
Summary of Fecal Coliform Contraventions

Sampling Station	Year				
	1970	1971	1972	1973	1974
MD 127	—	—	—	Aug.,Oct.	—
MD 90	—	—	—	—	N.O.
MD 89	—	Aug.	—	Oct.	—
MD 88	—	Aug.	—	Oct.	—
MD 87	Oct.	Aug.	—	Oct.	Aug.
MD 86	Oct.	Aug.(2)**	—	Aug.,Oct.	N.O.
MD 85	Oct.	Aug.	Sept.	Aug.,Oct.	—
MD 91	Oct.	Aug.(2)**	—	May,July Aug.,Oct.	—
MD 92	Oct.	Aug.(2)**	—	May,July Aug.,Oct.	N.O.
MD 93	—	Aug.(2)**	Sept.	May,July Aug.,Oct.	N.O.
MD 164	N.O.	N.O.	—	July,Oct.	N.O.
MD 163	N.O.	N.O.	—	July,Oct.	N.O.
MD 125*	N.O.	Aug.	Sept.	April	Aug.,Oct.,Nov.
MD 162*	N.O.	N.O.	June, July	March,April May,July, Oct.,Nov.	Jan.,March,May June,Aug.,Nov.
MD 161*	N.O.	N.O.	—	June	May,June,Aug., Oct.

N.O. No Observation

* Classified as SA

** Number of times contraventions occurred each month are shown in parentheses (if greater than 1).

tank areas, effluent from some existing waste treatment facilities, and urban runoff from stormwater discharges.

The EPA Report stated the flows from most stormwater discharges were insignificant during dry weather with respect to impact on the bacterial quality of the beach water. During periods of runoff, however, stormwater discharges can be a significant source of bacterial contamination.

The South Carolina Department of Health and Environmental Control initiated a sampling program of beach water at a number of Grand Strand beaches in 1973. Samples were analyzed for fecal coliform bacteria once a year during the summer months. Although the analyses were limited to only one sample per year, none of the maximums from any station exceeded the fecal coliform levels established for the primary contact recreation standard.

In addition to fecal coliform, the S.C. DHEC established a sampling and analysis program for chemical parameters at Pawley's Island public bathing beach and Cherry Grove public swimming area. However, the 208 effort has documented high fecal counts on beaches in the City of Myrtle Beach. A recommendation is being made to the city Council to close the beaches following rainstorms of three or more inches.

2.1.5 Ocean

The continental shelf off the Grand Strand is relatively flat and shallow, reaching a maximum depth of about 100 meters at the Florida-Hatteras slope, about 96 kilometers from shore. The Gulf Stream is located at the edge of this slope. The surface of the Continental Shelf contains a series of shelves, most of which have a relief of less than 10 meters, which help dissipate wave energy as a wave approaches a beach.

2.1.6 Sources of Wastewater

Ten municipal and three industry-owned wastewater treatment plants are presently operating in the Grand Strand planning region. The type, size, and daily flow characteristics are summarized in the facilities plan. The peak seasonal flow, which occurs from March through September, is three to six times greater than the flow generated by the permanent population.

In addition to the municipal plants, the Grand Strand region has many small, privately-owned and semi-public treatment facilities. Fifty-one private wastewater facilities have been identified and are also described in the facilities plan.

Much of the planning region is served by septic tanks. The suitability of the region's soil for septic tank usage ranges from moderate to extremely severe. The extremely severe rating applies to the wetland areas which represent approximately 40 to 50 percent of the total area. This rating is mainly due to a high groundwater table. Many complaints have been submitted to the Waccamaw Public Health Department by concerned citizens regarding adverse environmental effects of the septic tank disposal areas. The locations of the areas served by septic tanks, municipal wastewater treatment plants, private and semi-public wastewater plants, and industrial wastewater plants are indicated on the map presented as Figure 2-2.

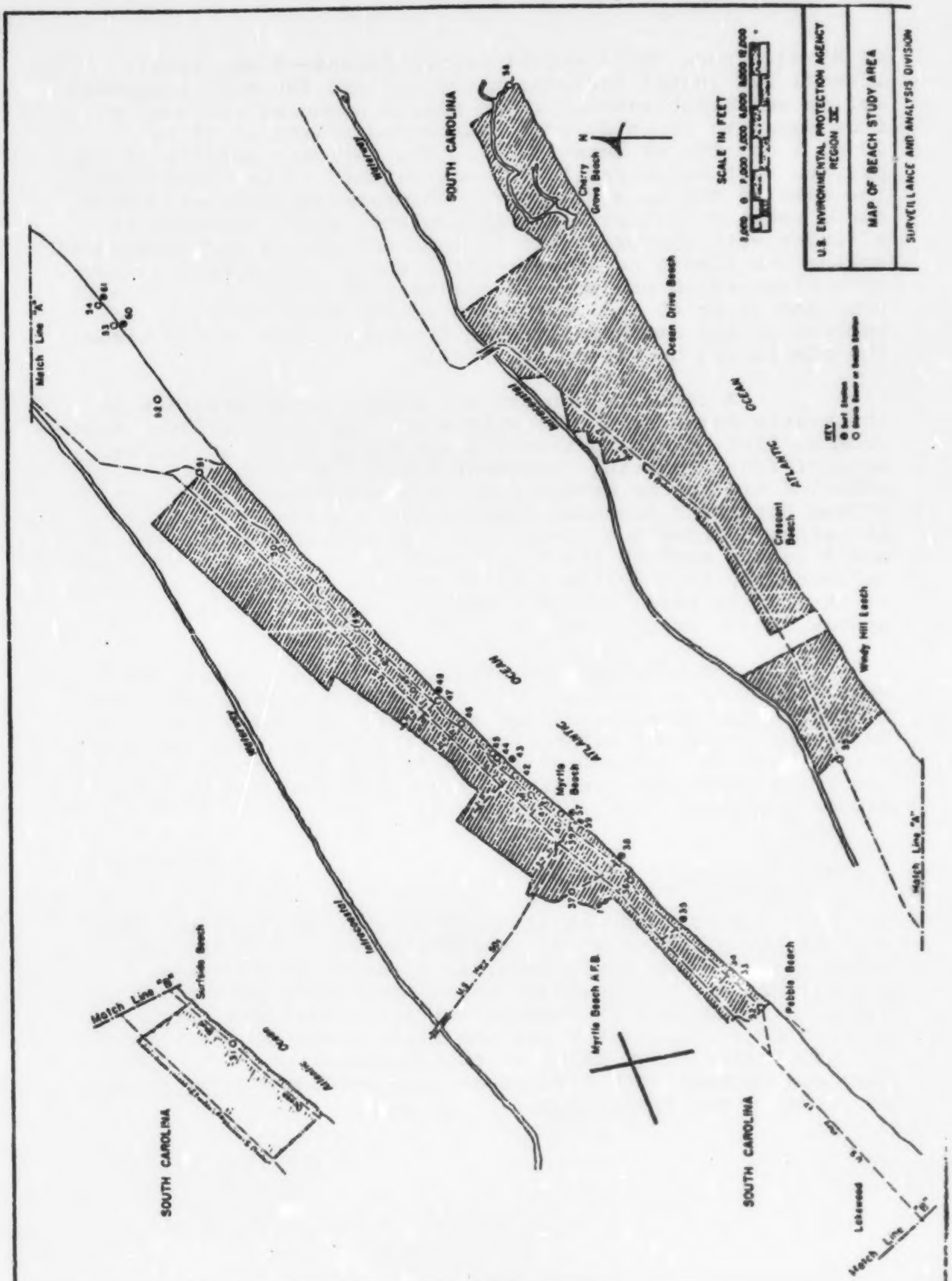
Water quality data indicate that very low nitrate and ortho phosphate concentrations exist in this area, which means that very little agricultural runoff occurs. The agricultural land use in the drainage area of the Waccamaw River and Intracoastal Waterway represents only 10 to 15 percent of the total area. Although silvaculture is widespread in this region, erosion does not appear to be a significant problem, because of the flatness of the land and the general sandy soil conditions.

The Grand Strand planning region has storm sewer systems in various areas. These systems separate from the sanitary systems and a large number of outfalls exist, especially in the Myrtle Beach area. Extensive work to determine the extent of pollution from urban runoff in this area has not been done and the Waccamaw Regional Planning and Development Commission is expected to investigate this area in its areawide wastewater management study being funded under Section 208 of the Water Quality Act amendments.

2.1.7 Characteristics of Wastewater

Based on tests of the six major treatment facilities of the Grand Strand region, which constitute 80 percent of the plant capacity of the area, a design influent

FIGURE 2-2
Map of Beach Study Area


U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
MAP OF BEACH STUDY AREA
SURVEILLANCE AND ANALYSIS DIVISION
SCALE IN FEET
KEY
● Surf Station
○ Storm Sewer or Swash Station
SOUTH CAROLINA
Cherry Grove Beach
Ocean Drive Beach
Crescent Beach
Windy Hill Beach
ATLANTIC OCEAN
Waterway
Intracoastal
Match Line "A"
Myrtle Beach
Myrtle Beach A.F.B.
Pebble Beach
Surfside Beach
Lakewood
Match Line "B"
Atlantic Ocean

of 80 mg/l BOD_5 (biochemical oxygen demand—5 day level), 25 mg/l TKN (total Kjeldahl nitrogen) and 200 mg/l suspended solids was established. These plants produced effluent of BOD_5 equal to 10 to 20 mg/l, suspended solids of 10 to 20 mg/l and TKN of less than 7. The influent quality of the private wastewater facilities was assumed to be approximately the same as the larger plants. The package plant effluents could range from a well-designed plant, which produces an effluent with approximately 10 mg/l BOD and 10 mg/l suspended solids and almost no ammonia-nitrogen, to a standard oxidation plant which produces an effluent of about 30 to 40 mg/l BOD_5 and 30 to 40 mg/l suspended solids with virtually no removal of the ammonia-nitrogen fraction. The ranges assume the plants are operated efficiently.

A construction project presently in progress in the Myrtle Beach area will ultimately result in a force main from N. 21st Avenue northward along Route 17 to as far as Briarcliffe. Existing treatment facilities that will be affected are Apache Campground, Lake Arrowhead Campground, Hilton Hotel and Arcadian Condominiums, Green Lakes Subdivision, Holiday Inn Travel Park, Briarcliffe Condominiums and a lagoon used by the City of Myrtle Beach. All the flow collected by this system will go through a 30" gravity sewer to the Myrtle Beach sewage treatment plant which is located approximately at 20th Avenue N. and Highway 317.

Industry-related effluents in the planning area result in a total flow of 0.44 mgd with an average effluent BOD_5 of about 60 mg/l. These effluents originate from the Wolverine Brass Works, American Gear & Pinion, and DBA Toyota Motors, and are considered insignificant when compared to the total discharge quantities from municipal and private sewage treatment facilities.

2.1.8 Aquatic Plants

Freshwater aquatic plants are not prevalent in most of the planning area's surface waters. The Waccamaw River is a "blackwater" river, as a result of decaying organic matter, and its dark waters generally prevent sunlight, an essential ingredient for plant survival, from penetrating. In areas along the river where some sunlight can penetrate, a few types of rooted-submersed plants persist and include such species as pond weed, Patamogeten spp., and water weed, Elodea spp.

Generally, plant life in the Waccamaw is abundant in the upper parts of the river, and somewhat scarce in the vicinity of its confluence with Winyah Bay. In the Intracoastal Waterway, pond weed and water weed are also abundant are are prevalent in most of the freshwater areas of the Waterway. Eel grass is the most dominant rooted-submerged saltwater plant species and is abundant near the beaches of the planning area.

2.1.9 Aquatic Life

The north coast district of South Carolina (Horry and Georgetown Counties), which includes the Grand Strand, is not an important commercial fishery area in comparison to the central and southern districts of the state. Table 2-5 outlines the South Carolina fish landings for 1973. The catch and dollar value for the northern district is significantly below the state's other two districts. Although the commercial fishing value is low, the sport fishing value is very high in the northern district. The Grand Strand region is presently noted for its very fine sport fishing and sport fishing facilities.

Sport fishing can be separated into three principal categories: freshwater, inshore, and offshore. Although these categories are somewhat arbitrary, the division is based on the general ecology of the three types of water, the species sought, and equipment and methods used in fishing.

Both freshwater and saltwater sport fishing serve as a great economic and natural resource for the Grand Strand region. The region ranks very high among sport fishermen and is the most heavily fished section of the state's coast. Statistics published in 1970 estimate approximately 175,000 South Carolina residents fish frequently and another 75,000 fish occasionally in the Grand Strand region. If nonresident saltwater fishermen were included, the total number would increase these totals by tens of thousands. Thus, the economic importance of this industry is significant. Facilities for fishing, boat rentals, over-night lodging, and selling tackle and other fishing equipment provide business opportunities for income production. The 1970 reports, based on conservative estimates, indicated that approximately 15,000,000 dollars were spent on saltwater fishing in the state.

Table 2-5
South Carolina Landings by Districts, 1973

SPECIES	DISTRICT					
	NORTHERN		CENTRAL		SOUTHERN	
FISH	POUNDS	DOLLARS	POUNDS	DOLLARS	POUNDS	DOLLARS
Alewives	—	—	432,893	12,980	—	—
Bluefish	3,100	643	—	—	—	—
Catfish	214,000	36,300	664,300	117,868	—	—
Croaker, Unclassified	450	54	1,989	297	550	75
Drum, Black	141	21	—	—	—	—
Drum, Red (Redfish)	—	—	—	—	620	155
Eels, Common	2,300	345	53,050	8,862	—	—
Flounders, Unclassified	9,487	2,417	43,208	9,329	21,711	4,890
Groupers	66,433	24,067	16,290	5,263	—	—
Grunts	3,500	530	1,277	609	—	—
King Mackerel	10,455	4,482	325	200	—	—
King Whiting Dr 'Kingfish"	24,245	4,081	113,316	17,951	55,858	9,257
Mullet	239,935	26,690	—	—	—	—
Pompano	632	143	3,964	1,491	396	148
Scup or Porgy, Unclassified	18,459	3,757	2,614	898	—	—
Sea Bass, Unclassified	120,154	38,211	167,296	48,127	1,107	552
Sea Trout, Grey	1,823	469	—	—	50	10
Sea Trout, Spotted	2,000	674	1,910	694	1,813	678
Shad	25,318	11,312	900	495	—	—
Sharks	4,258	421	11,537	1,233	515	68
Sheepshead, Saltwater	—	—	—	—	350	53
Snapper, Red	11,091	10,194	5,859	6,555	—	—
Snapper, Vermilion	4,878	2,302	639	530	—	—
Spanish Mackerel	2,300	331	1,494	185	300	55
Spot	1,403,592	227,000	42,128	4,644	9,460	1,190
Sturgeon	44,365	13,178	—	—	—	—
TOTAL FISH	2,212,976	407,622	1,579,989	238,217	92,730	17,131
SHELLFISH						
Crabs, Blue, Hard	92,499	12,701	2,408,060	420,358	5,451,400	710,563
Shrimp, Saltwater (Heads-on)	1,193,533	1,352,225	4,215,787	4,480,809	2,846,792	3,073,750
Clams, Hard (Meats)	14,769	7,347	32,142	15,289	48,089	23,426
Octopus	1,000	150	—	—	—	—
Oysters (Meats)	56,137	29,662	244,444	130,951	577,433	344,749
Squid	1,347	202	3,109	335	741	87
TOTAL SHELLFISH	1,359,285	1,402,287	6,903,542	5,047,742	8,924,455	4,152,575
GRAND TOTAL	3,572,261	1,809,909	8,483,531	5,285,959	9,017,185	4,169,706

For freshwater fishing the most popular fish species are largemouth bass, crappie, bream, bullheads, catfish, white perch, and pickerel. Striped bass, shad, alewives and other anadromous species that travel up freshwater streams to spawn provide additional species for the fishermen.

Inshore fishing, which includes estuaries, provides the greatest variety of species for sport fishing. Many coastal marine and freshwater species can be found in estuaries. Varying degrees of salinity and temperature provide a diverse environment with many habitat variations. Tidal creeks and sloughs extend habitats into adjacent marshes and provide the essential nutrients to support the energy base and food webs for this rich biological and productive zone. Fresh, brackish, and saltwater creeks, channels and the more open estuarine reaches and inlets offer rich opportunities for catching sea trout, pompano, drum, spot, whiting, catfish and flounder. Several other species such as cobia, bluefish, and crevalle jack are frequently found in the more open inlet waters and near the shoreline of beaches. Several species of shark are also receiving interest as sport fish.

An offshore fishing method often used by sport fishermen is bottom fishing for sea bass, snappers, grouper, and similar species that are attracted to the ocean floor structure. Trolling for kingfish, dolphin, and billfish (i.e., marlin), and casting into schools of bluefish, cobia and mackerel are other popular methods of offshore and deep-sea fishing.

Appendix A provides an inventory of the major saltwater fish species which can be found in the ocean and estuarine areas of the Grand Strand. The appendix also provides an inventory of the major freshwater species found in streams and rivers.

2.2 GROUND WATER

All potable water is supplied from ground water on the Grand Strand either through private wells or public and semi-private water systems. The number of wells, the quantity pumped, storage capabilities, types of treatment, a description of service area, rate structures and notes of future considerations are presented in Table 2-6.

Table 2-6

Existing Public and Semi-Public Water Systems in the Grand Strand Area

Water System	# of Wells	Yield (gpm)	Storage Capabilities	Type of Treatment	Service Area	Rate Structure	Future Considerations
Briarcliffe	2	305	50,000 gal. overhead storage	Chlorination	Briarcliffe areas & Briarcliffe West	$15.00/Quarter (up to 9000 gal.) $1.00/1000 gal. for next 12,000 gal. $.60/1000 gal. over 21,000 gal.	No plans at moment
Garden City	4	480	300,000 gal. reservoir	Chlorination	Garden City Beach Surfside to 13 Ave. (will serve James-condominium?)	$15.75/Quarter (up to 13,000 gal.) $1.05/1000 gal. above 13,000 gal.	Will purchase two more wells for a yield of 500 gpm and in the next year will drill for a 300-400 gal. well.
Litchfield	2	500	300,000 gal. storage tank	Chlorination	All of Litchfield Island-Litchfield Country Club	$7/month (up to 3,000 gal.) $1.25/1000 gal. for next 2,000 gal. $1.00/1000 gal. over 5,000 gal.	Plan to drill for a 250 gpm well. Will be tied with Pawley's Island System.
Little River	1	300	75,000 gal. storage tank	Chlorination	Little River and some surrounding area	$5/month (up to 2,000 gal.) $1.50/1000 gal. for next 2,000 gal. $1.00/1000 gal. for next 2,000 gal. $.50/1000 gal. for next 5,000 gal. $.35/1000 gal. for next 10,000 gal. $.32/1000 gal. for next 10,000 gal. $.30/1000 gal. over 32,000 gal.	Going in two wells at 125 gpm; add new high pressure pneumatic storage; might purchase a well but no other new plans.

Table 2-6 (continued)

Water System	# of Wells	Yield (gpm)	Storage Capabilities	Type of Treatment	Service Area	Rate Structure	Future Considerations
Myrtle Beach	19	6,920	3-10,000 gal. pressure tanks 12 tanks totaling 3,950,000 gal. of elevated storage	chlorination	From Atlantic Ocean West to intracoastal waterway, Northward about 1 mile north of Hilton Hotel complex, southward to 1 mile south of air force base but city doesn't serve AFB or its housing.	Rates vary with meter size and consumption.	Water system under study. 500,000 gal. elevated storage will replace one 10,000 gal. pressure.
North Myrtle Beach	7	2,800	650,000 gal. of elevated storage	chlorination	Ocean drive Wind hill Cherry Grove Area Crescent Beach Atlantic Beach	$4/month (up to 3000 gal.) $50/1000 over 3000 gal.	Expect drilling an operation of a 500 gpm well in next 6 months. Also plan to have two more wells and three more high storage tanks.
Pawley's Island	2	435	depression storage	chlorination	All of Pawley's Island except about 40 homes (hope to get contract to service on mainland)	$7/month (up to 3,000 gal.) $1.25/1000 gal. next 2,000 gal. $1.00/1000 gal. over 5,000 gal.	Plan to get one storage tank of 200,000 gal. size. Will be tied with Litchfield system.
Surfside Beach	2	920	one 300,000 gal. - two 5,000 gal. storage tanks	chlorination	All surfside beach except from 13 Ave. which Garden City services.	$8.50/bimonthly (up to 8,000) $.75/1000 gal. for next 6,000 $.50/1000 gal. for next 10,000 $.40/1000 gal. for next 20,000 $.20/1000 gal.	In next 2-3 years, plan to get 1 well of 500 gpm and 1 storage tank of 300,000 gal.

However, physical and chemical information characterizing the ground water regimes in the Grand Strand region is lacking. Population growth within the area and concern for depletion and potential saltwater intrusion have induced officials of Myrtle Beach, Horry County, and Georgetown County to submit a request to the South Carolina Water Resources Commission for a "Capacity Use" study of the Grand Strand under the South Carolina Ground Water Use Act of 1969.

The "Capacity Use" study was initiated as a joint effort by the Water Resources Commission and the United States Geological Survey late in 1972. The study was completed and published in 1976. Discussions with Mr. Allan Zack, who is conducting the study for USGS, and Mr. B.C. Spigner, who is conducting the study for the South Carolina Water Resources Commission, provided the information concerning present groundwater resource conditions. Preliminary findings to date indicate that:

- There are sufficient ground water resources in the Grand Strand of suitable quality to sustain projected growth as long as wells are properly constructed.
- There is no evidence of saltwater intrusion into the aquifers.

Ground water resources of the Grand Strand include the water table aquifer and two confined or artesian aquifers, the Pee Dee-Black Creek and the Tuscaloosa.

2.2.1 Water Table Aquifer

The water table aquifer is approximately 80 feet in depth and consists of interlayered sands, silts, and clays of the Pliocene, Pleistocene and Holocene ages. This aquifer is largely unconfined except in a few places where the aquifer is under artesian or confined conditions.

A chemical analysis was performed on the ground water from the water table aquifer and Table 2-7 presents the results of this analysis. The water sample was taken from a 32-foot well at the Myrtle Beach Air Force Base and is considered to be typical of this aquifer. The analysis indicates that the groundwater quality meets the U.S. Public Health drinking water standards except for an excess of iron. The standard for iron is 0.3 mg/l, and 2.7 mg/l was found in the Myrtle Beach Air Force Base well water.

Table 2-7
Chemical Analysis of Water from the Water-Table Aquifer*
Grand Strand, South Carolina

Dissolved solids (residue at 180°C)	132
Specific conductance (micromhoe at 25°C)	218
pH	7.0

	mg/liter
Silica (SiO_2)	13
Iron (Fe)	2.7
Calcium (Ca)	30
Magnesium (Mg)	1.6
Sodium (Na)	12
Potassium (K)	0.4
Bicarbonate (HCO_3)	93
Sulfate (SO_4)	2
Chloride (Cl)	20
Fluoride (F)	0.1

---

* Taken from a 32 foot well at the Myrtle Beach Air Force Base.

Water from the water-table aquifer is principally used as a rural domestic resource. The northern portion of the Grand Strand also uses this aquifer as a resource because of the lower water quality of the Pee Dee-Black Creek aquifer in this area. The usage, however, is very small in comparison to the usage in the rural areas. The aquifer is not used extensively at the present time and could provide many additional small supplies to the rest of the Grand Strand region.

2.2.2 Pee Dee-Black Creek Aquifer

The Pee Dee-Black Creek aquifer is the principal aquifer of the area and lies directly beneath the water table aquifer. The aquifer is artesian and consists of about 700 feet of interlayered sands, silts, and clays.

A chemical analysis of the groundwater from the Pee Dee-Black Creek aquifer was performed and the results are presented in Table 2-8. Water samples from four wells were taken and analyzed. These wells are located in Little River, Myrtle Beach, Garden City, and near Georgetown. The analyses show increasing dissolved solids, chlorides, calcium, magnesium, sodium, and fluoride concentrations from south to north. The apparent explanation for this higher salinity in the northern portion of the Strand, as indicated by Mr. Zack of the USGS, is ancient sea water intrusion which has not been flushed out by fresh water as yet. The analyses also indicate that the groundwater conforms to the U.S. Public Health Service drinking water standards except for an excess of fluoride in the water from the wells of Little River, Myrtle Beach, and Garden City; chloride from Little River; and dissolved solids in the well water from all locations.

During the summer tourist season, the water level of the Myrtle Beach well is approximately 11 feet below the winter level. The hydraulic properties of the Pee Dee-Black Creek aquifer at Myrtle Beach have been determined based on two pumping tests. The analysis of one test gave a transmissivity of 21,000 gpd (gallons per day)/ft., and the other was 15,000 gpd/ft. Both pumping tests gave a storage coefficient of 3×10^{-4}, which is small and typical of artesian aquifers.

Groundwater from the Pee Dee-Black Creek aquifer is the most widely used resource on the Grand Strand. All

Table 2-8
Chemical Analysis of Water from the Pee Dee - Black Creek Aquifer, Grand Strand, South Carolina

Location of Well	Little River	Myrtle Beach	Garden City	Grand Strand near Georgetown (Arcadia)
Depth of Well (feet)	658	800	804	—
Specific conductance (Micromhos at 25°C)	2390	1300	1260	856
pH	8	8.2	8.4	8.4
Alkalinity as $CaCO_3$ (mg/l)	586	522	593	428
Bicarbonate (HCO_3) (mg/l)	714	636	642	479
Carbonate (CO_3) (mg/l)	0	0	40	21
Hardness as $CaCO_3$ (mg/l)	28	13	8	7
Calcium (Ca) (mg/l)	6.3	3.3	2.4	2.1
Magnesium (Mg) (mg/l)	3.0	1.2	0.6	0.4
Sodium (Na) (mg/l)	560	310	320	220
Potassium (K) (mg/l)	12	7	4.5	4.7
Chloride (Cl) (mg/l)	440	100	59	27
Sulfate (SO_4) (mg/l)	4.6	4	3.7	6
Fluoride (F) (mg/l)	5.2	4.4	4.0	0.9
Silica (SiO_2) (mg/l)	14	15	19	18
Iron (Fe) (mg/l)	0.13	0	0.01	0.1
Dissolved solids (residue at 180°C)	1400	790	772	537

municipal systems, many industries and businesses as well as individual wells, draw water from this aquifer. Properly constructed wells can produce between 700 and 1,000 gpm of water which is of good quality except for fluoride content.

2.2.3 Tuscaloosa Aquifer

The Tuscaloosa aquifer is the deepest aquifer and lies below the Pee Dee-Black Creek aquifer. This aquifer consists of between 300 and 400 feet of interbedded sand, silts, and clays of the Tuscaloosa geologic formation. The water is confined under artesian conditions with about 10 to 50 feet of clay.

Very little information concerning this aquifer is available because of the limited wells extending into it in the Grand Strand region. The chloride content is high (3,770 to 4,500 mg/l in a well near Calabash) and has not been used as a water resource. As indicated for the Pee Dee-Black Creek aquifer, the mineral content decreases from the north to south. The source of this salinity is also believed to be caused by ancient sea water intrusion.

2.2.4 Recharge and Discharge

Very little is known about the characteristics of the recharge areas for the Pee Dee-Black Creek or Tuscaloosa aquifers and extensive studies have not been conducted to locate these areas or determine the rates of inflow. The relative locations of the recharge areas are most likely where the Pee Dee formation, Black Creek formation, and Tuscaloosa formation outcrop, which are northwest of the Grand Strand. For the Water Table aquifer, the recharge is due to local precipitation that percolates through the soil surface to the aquifer.

The water movement in the Grand Strand aquifers is typical of coastal area aquifers. Movement in the Tuscaloosa and Pee Dee-Black Creek aquifers is slow (a few feet per day) and in a horizontal direction from the recharge areas toward the discharge areas along the coast. In the discharge area, a part of the water moves upward slowly from the Tuscaloosa to the Pee Dee-Black Creek, then to the water table aquifer and finally to the ocean.

Heavy pumping activities near areas such as Myrtle Beach have lowered the recharge potential of the Pee Dee-Black Creek aquifer and have caused a significant change in water movement. As a result of these activities, water from the water table aquifer will leak slowly into the Pee Dee-Black Creek and increase the velocity of the horizontal movement within the Pee Dee-Black Creek.

2.2.5 Salt Water Encroachment

Salt water encroachment of the Pee Dee-Black Creek aquifer has been a major concern in the Grand Strand area. Ground water quality has been degraded because of this intrusion which has resulted in higher chloride concentrations in the northern portion of the Strand and lower recharge potential (45 to 50 feet below sea level) of the aquifer at Myrtle Beach. The concern over ground water quality initiated the Grand Strand Capacity Use Study which has been published recently.

According to Mr. Allan Zack of the USGS, the Pee Dee-Black Creek aquifer is a confined or artesian aquifer and has no direct connection with the ocean. Thus, the probability of salt water intrusion is very small, even if the fresh water head is reduced. The data collected to date indicate that the higher chloride content in the northern portion of the aquifer could be due to ancient sea water trapped in the aquifer. The USGS data does not show any evidence of salt water intrusion, and future problems are not expected as long as wells are properly spaced and constructed.

2.3 WATER-LAND INTERFACES

2.3.1 Flood Plains

Detailed intermediate regional flood profiles or a 100-year flood stage analysis (frequency of flooding over a 100-year period) have not yet been determined on the Grand Strand. However, the U.S. Geological Survey has computed the "flood prone" areas using precipitation data, stream gauging, and topographic maps. The flood prone areas, therefore, are approximations of the 100-year flood stage areas, which are indicated in Figure 2-3.

2.3.2 Beaches

The Grand Strand has 57 miles of unbroken, gently curving shoreline. The Grand Strand is one of the nation's finest strands with beaches measuring over 500 feet at low tide and extending from the North Carolina state line south to the Waccamaw Neck. This expansive shoreline is the focal point for tourist and recreational development which has occurred on the Grand Strand.

Many different classifications have been used to define coastal systems. They have been somewhat biased by the particular discipline of the person classifying the system. Salinity, rock formations, benthic organisms, wave action, as well as other characteristics, have all been used to classify shorelines. Odum, et.al. has developed an energy classification of shorelines which ranks systems according to the level of energy within the system. This method of classification has been proposed as one of the very few existing common denominators considering the high degree of variability in the coastal areas of the world.

The entire Grand Strand beach area is considered by Odum to be an A-2 type, a high energy sandy beach with the associated characteristics of high energy breaking waves. The environment presents a naturally stressed ecosystem resulting in lower biological diversity as compared to an unstressed environment. At the same time, this environment results in an assemblage of biological communities which are uniquely adaptable to the situation.

The high energy beaches are sandy shores which receive the pounding of wind driven waves and the daily ebb and flow of tides that result in the zonation of sand particles from coarse to very fine. These high energy waves

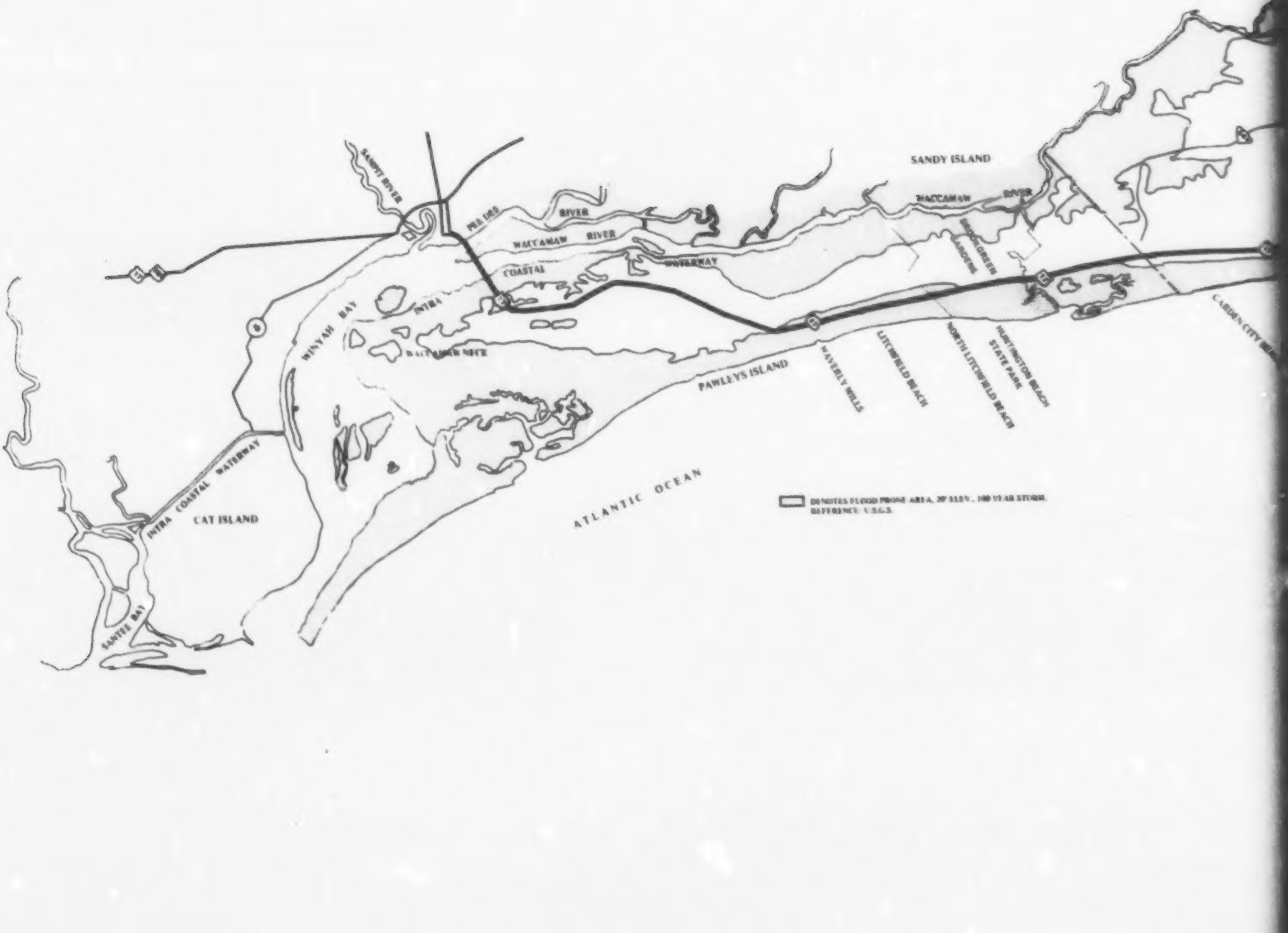
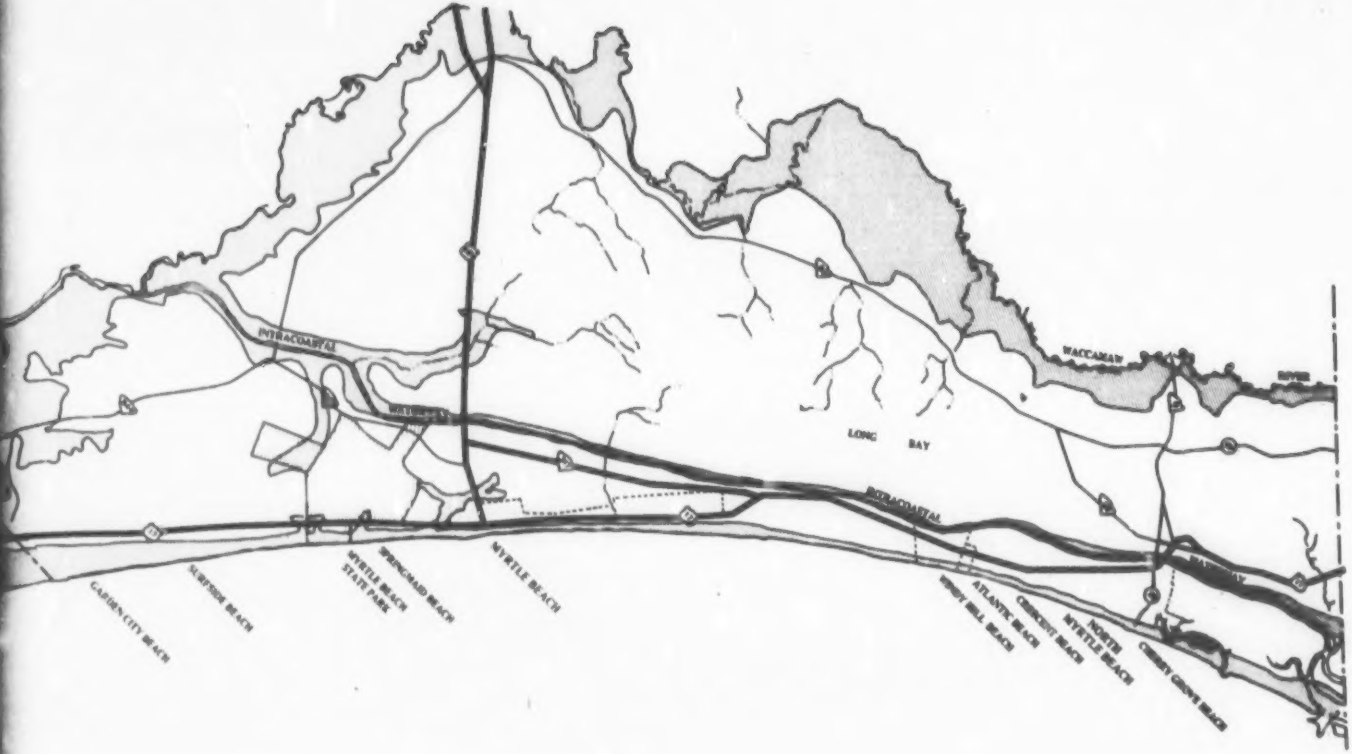
SAMPIT RIVER
PEE DEE RIVER
WACCAMAW RIVER
SANDY ISLAND
WACCAMAW RIVER
INTRA COASTAL WATERWAY
WINYAH BAY
WACCAMAW NECK
BROOKGREEN GARDENS
PAWLEYS ISLAND
WAVERLY MILLS
LITCHFIELD BEACH
NORTH LITCHFIELD BEACH
HUNTINGTON BEACH STATE PARK
GARDEN CITY
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
DENOTES FLOOD PRONE AREA, 10' ELEV., 100 YEAR STORM.
REFERENCE: U.S.G.S.

FIGURE 2-3
Flood Prone Areas


INTRACOASTAL
WATERWAY
WACCAMAW
RIVER
LONG BAY
INTRACOASTAL
WATERWAY
GARDEN CITY BEACH
SURFSIDE BEACH
MYRTLE BEACH STATE PARK
SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH

have produced a number of critical erosion problems along the Grand Strand coastline particularly in the Myrtle Beach area, Murrells Inlet area, and Pawleys Island Midway Inlet area. A number of groins (small jetties extending from the shore) have been constructed in these areas in an effort to control the erosion.

This ecosystem provides the habitat for the sand dwellers or psammon, which is Greek for sand. Some of the fauna are found entirely below the water line, some high on the beach, and some at the water line where debris accumulates. The epipsammon (fish, shorebirds, etc.) live on or above the sand surface; the endopsammon (snails, clams, crustaceans, etc.) burrow beneath the sand surface; and the mesopsammon (diatoms, ciliates, turdigrades, copepods, etc.) live in the interstices between the sand grains. The beach and its associated sand organisms form an extensive food filtering system using detritus and converting it to biomass. No higher forms of algae are found in the beach areas except those that are washed ashore. The high energy beach does not provide a suitable substrate for attachment of higher plant life.

The epipsammon are adapted to collecting the endopsammon or their cadavers for a food source. The endopsammon are either carnivores or herbivores of the filter feeder type and feed on various forms of plankton as it is swept past them by the tides and wave action. The endopsammon do not contain any autotrophs.

The mesopsammon demonstrate the greatest diversity as they are uniquely adaptable to living in the specialized area of the interstial environment. The typical characterization of the trophic structure shows a low number and very few types of primary producers, a small number of filter feeders, and a high diversity of detritus feeders and decomposers. Decomposers maintain an important position in the beach ecosystem. Although the input and output energy relationships of the beach ecosystem are not well understood as well as the specific relationship of the decomposers and the remainder of the ecosystem, the major energy sources driving the system are both the wave action and the washed-in detritus.

The beaches along North Island provide nesting sites for several species of sea turtles. The principal species are the Atlantic logger head (Caretta caretta) and more rarely the leatherback (Dermochelys corriacae) and ridley (Lepidochelys hempii).

The vascular vegetation of the beaches and sand dunes is dominated by sea oats (Uniola paniculata) and cordgrass (Spartina patens). The most common organisms found in the beach area below the low tide line include blue crabs, horseshoe crabs, sand dollars, and a variety of mollusks. In the intertidal zones, wedge shells, mole crabs, and a number of polychaet worms may be found. Ghost crabs and beach fleas may be found in the beach berm. The beach area is utilized by a variety of shorebirds, including the American oystercatcher, plovers, willet, sandpipers, lesser and greater yellowlegs, gulls, and terns.

2.3.3. Estuaries and Salt Water Marshes

Pritchard developed the following definition of an estuary, which has become widely accepted:

> "An estuary is a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measureably diluted with freshwater from land drainage. The estuary is a place where the tide meets river currents."

Estuaries are highly complex and variable water systems which have constantly changing environmental conditions. This condition is caused by the interaction of two opposing current systems, the unidirectional stream currents and the oscillating tidal currents, in the area where inland freshwater interfaces with the saltwater from the ocean. These situations produce transition zones or ecotones between freshwater and marine habitats. Freshwater-unique species generally do not frequent the transition zones and the same is true for saltwater-unique species. Estuary aquatic life, therefore, consists of species that are more tolerant of changes in such environmental conditions as salinity and temperature.

The number of estuaries and saltwater marshes on the Grand Strand is small in comparision to the remaining section of the South Carolina coastline. As previously mentioned, the major attraction at the Strand is the long beachline. The most significant estuaries and salt marsh areas of the Grand Strand include:

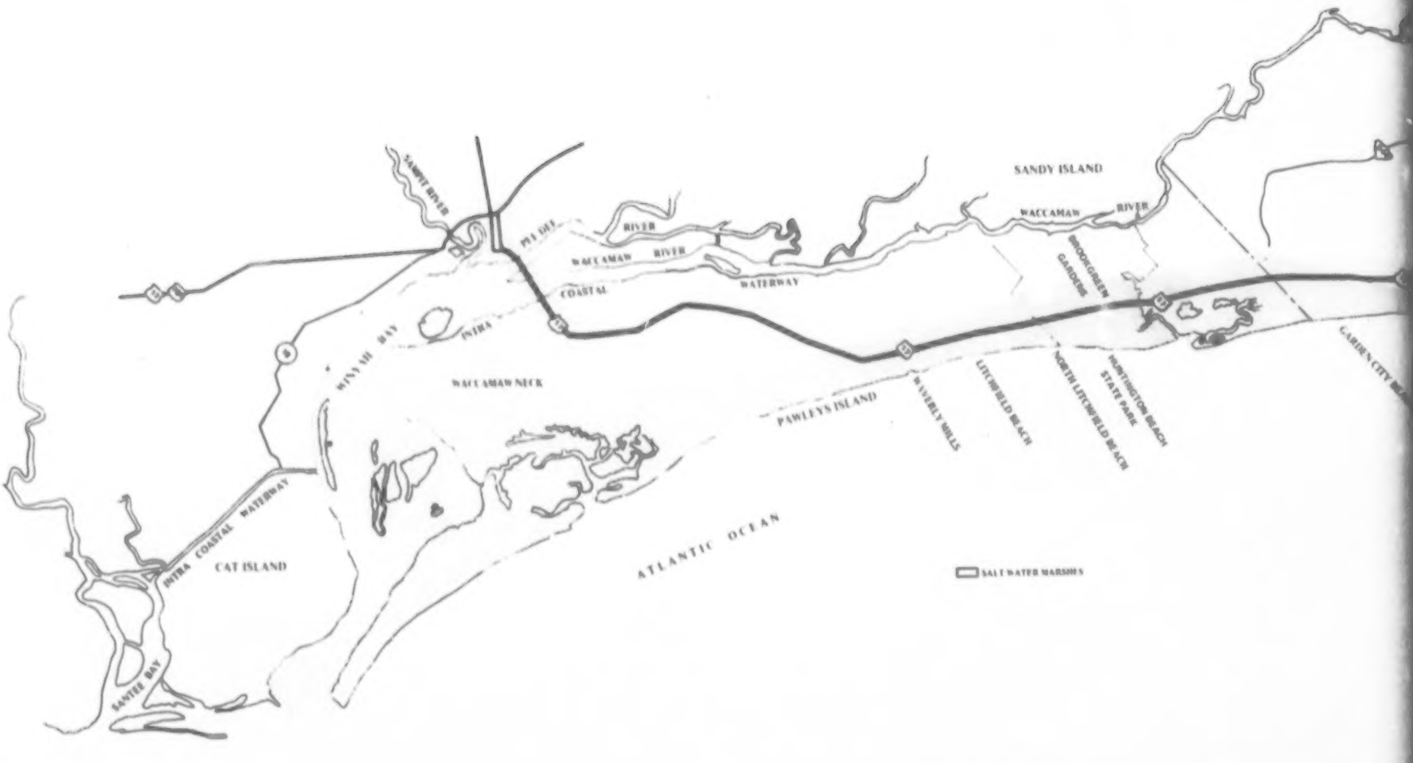
- Winyah Bay and associated North Inlet
- Midway Inlet in the vicinity of Pawley's Island and Litchfield Beach
- Murrells Inlet area
- Little River Inlet.

The locations of these areas are indicated on the map, Figure 2-4, and based on coastal zone maps provided by the South Carolina Department of Wildlife and Marine Resources.

The Grand Strand saltwater marshes are primarily Type 18 salt marshes (low marsh) surrounded by a few Type 17 salt marshes (high marsh). These classifications have been defined by the Fish and Wildlife Service's Circular 39, "Wetlands of the United States". Type 18 classified marshes are salt marshes regularly flooded by tidal actions, whereas Type 17 classified marshes are salt marshes irregularly flooded by saltwater tidal actions.

Estuaries and associated salt marshes represent some of the most naturally productive ecosystems. Estuaries are more productive than either the ocean or inland freshwater systems. An estuary can physically and biologically trap or collect nutrient material from detritus washed into the estuary during tidal cycles. The detritus is deposited in the saltwater marshes each year and is present when the cordgrass dies and decomposes.

Since organisms living in an estuary must be able to withstand large changes in salinities, estuarine communities are typically composed of endemic species as well as tolerant species from both the ocean and freshwater. Several kinds of commercially important shrimp (white and brown shrimp) live and spawn in the ocean but enter estuaries as larvae. The estuaries provide the necessary habitat and spawning conditions for these shrimp as well as for the blue crab. In addition, juveniles of sport and commercial fish species feed regularly in the estuary. Estuaries in the Grand Strand region have high mollusk productivities. Little River Inlet has a particularly abundant population of hard clams and Murrells Inlet has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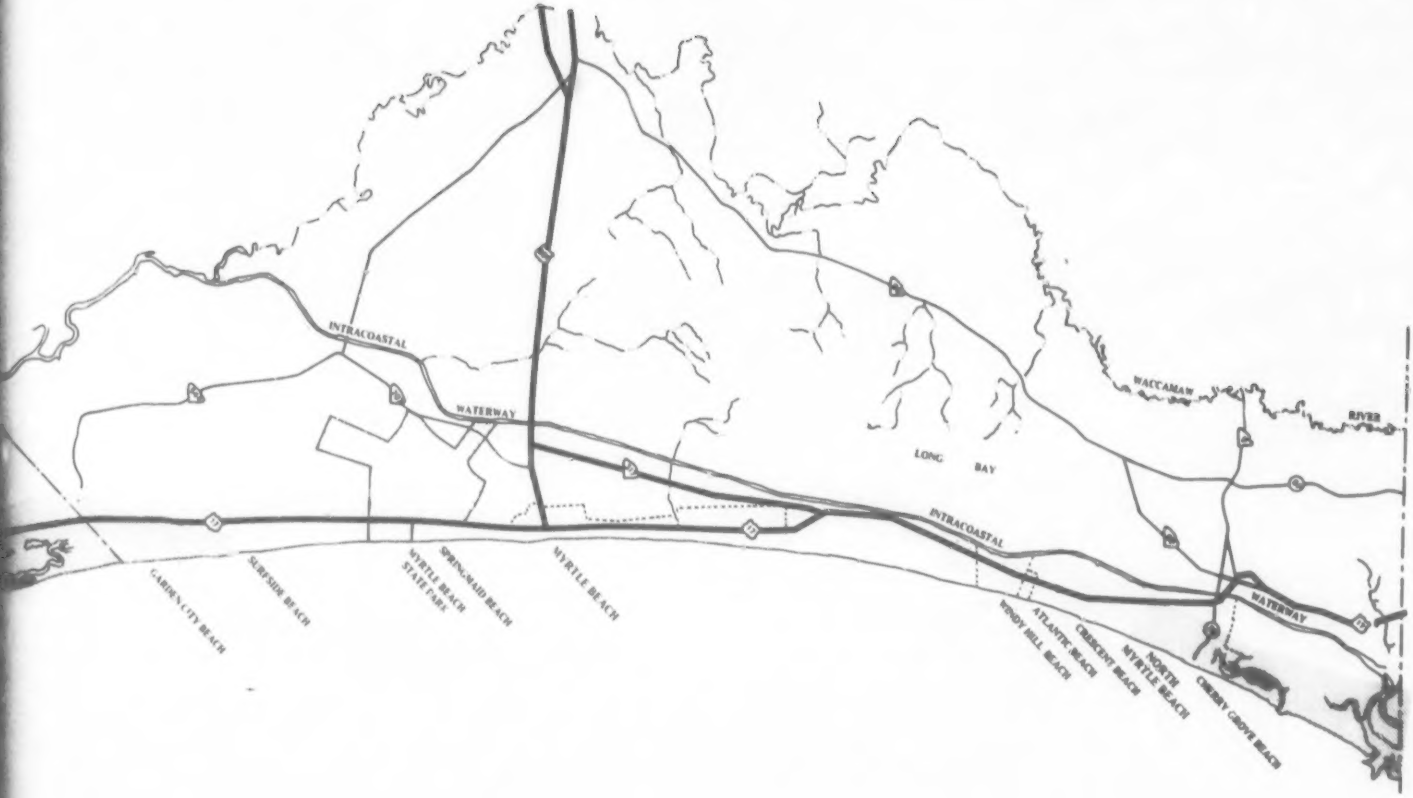
WINYAH BAY
WACCAMAW NECK
BROOKGREEN
GARDENS
PAWLEYS ISLAND
WAVERLY MILLS
LITCHFIELD BEACH
NORTH LITCHFIELD BEACH
HUNTINGTON BEACH
STATE PARK
GARDEN CITY BEA
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
SALT WATER MARSHES

FIGURE 2-4

Estuaries, Salt Marshes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SURFSIDE BEACH
MYRTLE BEACH STATE PARK
SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH

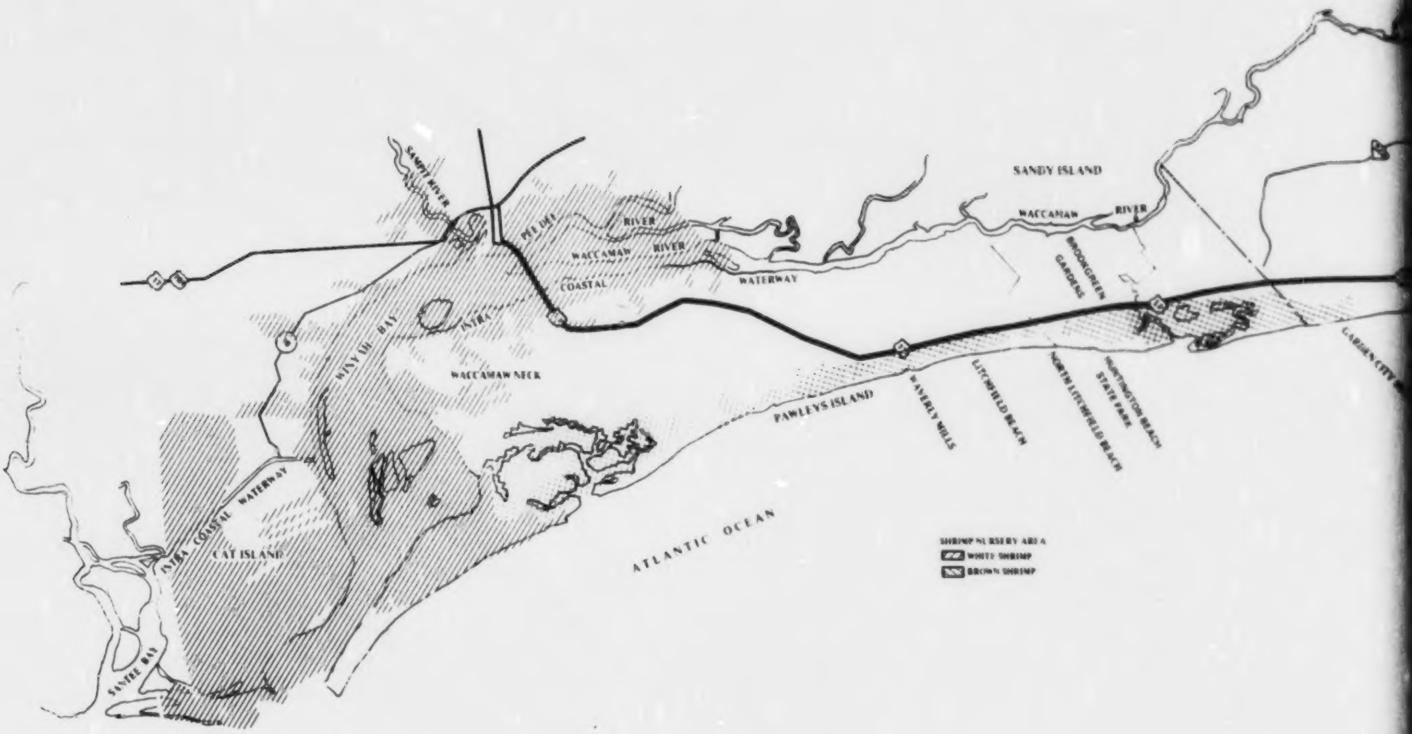
a substantial population of oysters. Figure 2-5 shows the locations of important nursery areas for shrimp, clams, and oysters in the estuaries of the Grand Strand.

The Belle W. Baruch Institute for Marine and Coastal Research, University of South Carolina, has conducted a study to identify the species of the North Inlet and a rather extensive list of fishes, benthic algae, and macroinvertebrates has been compiled. This list is in Appendix A and is representative of the organisms which can be found in the estuaries and adjoining salt marshes along the Strand.

The vegetation in the Grand Strand marshlands varies with elevation and salinity. The soil characteristics of these marshlands are generally poorly drained peats and mucks in which anaerobic conditions usually exist below ground surface. Low marsh is the more predominant type of marshland in the planning region and is usually a part of extensive high marsh areas. Low marshland occurs from mean sea level to about mean high tide. This marsh type is characterized by a monospecific plant community, such as smooth cordgrass(*Spartina alterniflora*). The low marsh is alternately inundated and drained, flooded and exposed, by each tidal cycle. The salt marsh community represents a tide stressed environment with wide variations of three environmental factors: salinity, wetness, and temperature. Plants and animals inhabiting salt marshes must be able to tolerate these environmental stresses.

High marshland occurs above the mean high tide and is irregularly flooded by tides above mean high tide. The vegetation is more varied and typically consists of smooth cordgrass, wiregrass (*Spartina patens*), needlerush (*Juncus roemerianus*), glasswort (*Salicornia virginica*), spikegrass (*Distichlis spicata*), as well as a variety of other grasslike plants. The smooth cordgrass found in high marshes is stunted in comparison to that found in low marshes.

The two major herbivores of the salt marsh community are the salt marsh grasshopper, which eats smooth cordgrass tissues, and the salt marsh planthopper, which sucks the juices of smooth cordgrass. A very low proportion of biological energy in the salt marsh permeates the herbivore based food chain. The largest percentage of the marsh's primary productivity is detritus which is produced by decomposition of cordgrass and wiregrass at the mud interphase. Such organisms as fiddler crabs, horse mussels, salt marsh periwinkles, and oligochaetes utilize this detritus as a food source. The organisms may, in turn, be eaten by mud crabs, clapper rails, and raccoons.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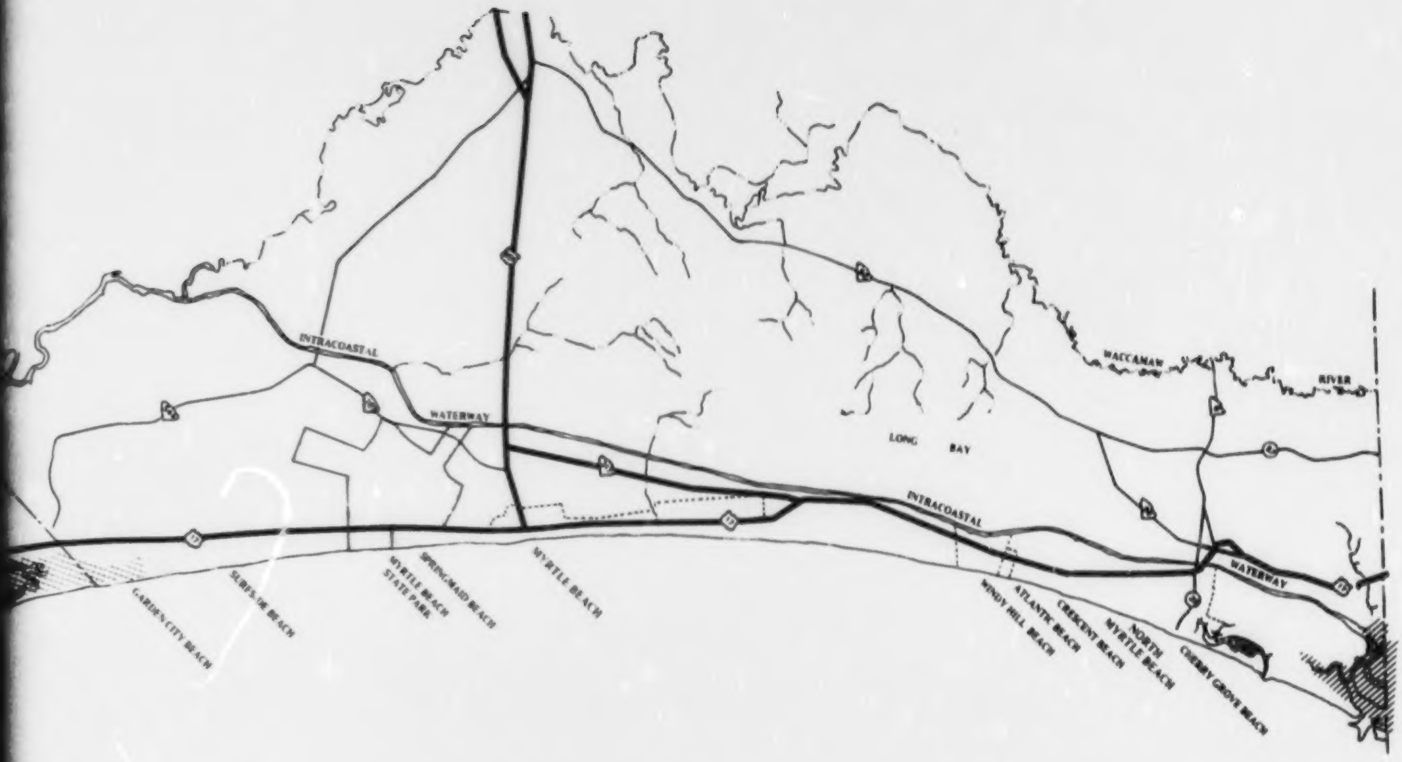
WINYAH BAY
WACCAMAW NECK
PAWLEYS ISLAND
WAVERLY MILLS
LITCHFIELD BEACH
NORTH LITCHFIELD BEACH
HUNTINGTON BEACH
STATE PARK
GARDEN CITY
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
SHRIMP NURSERY AREA
▨ WHITE SHRIMP
▨ BROWN SHRIMP

FIGURE 2-5

Nurseries for Shrimp, Clams, and Oysters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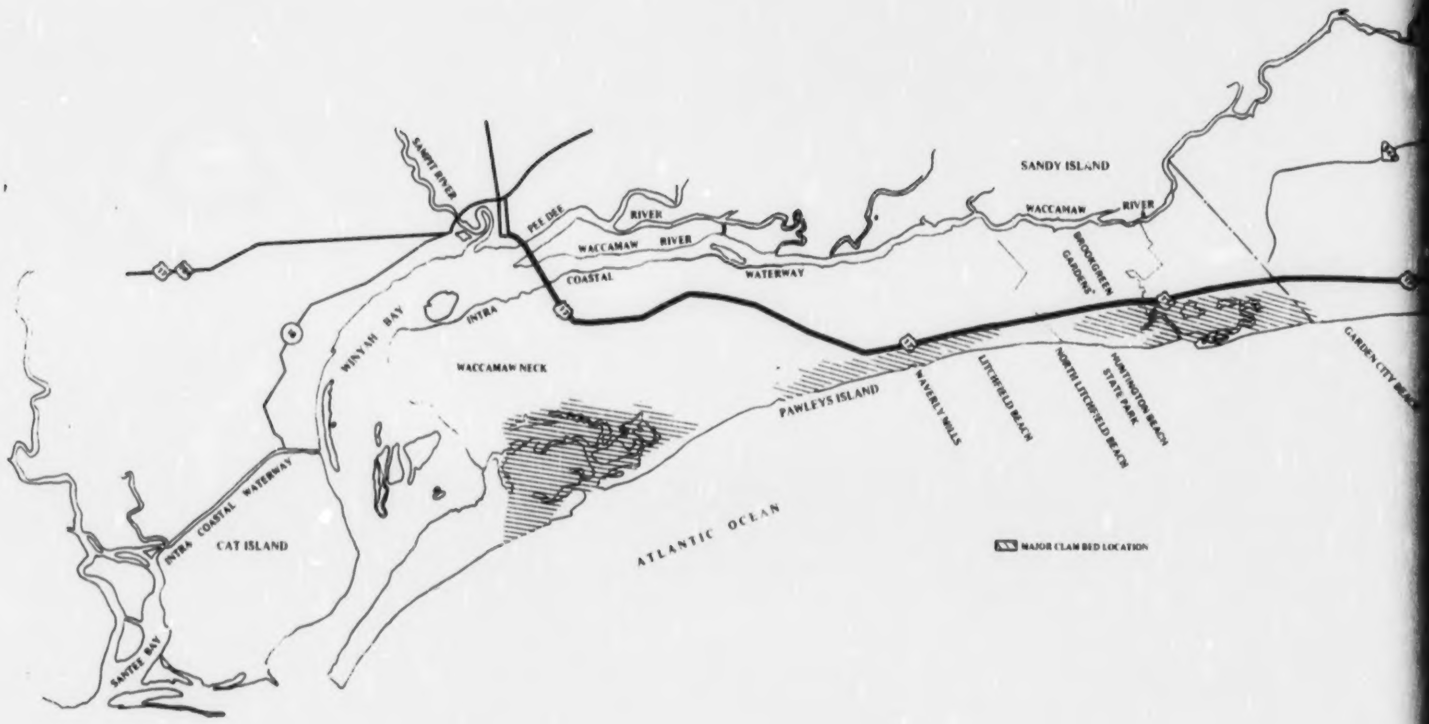
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH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HUNTINGTON BEACH STATE PARK
GARDEN CITY BEAC
INTRA COASTAL WATERWAY
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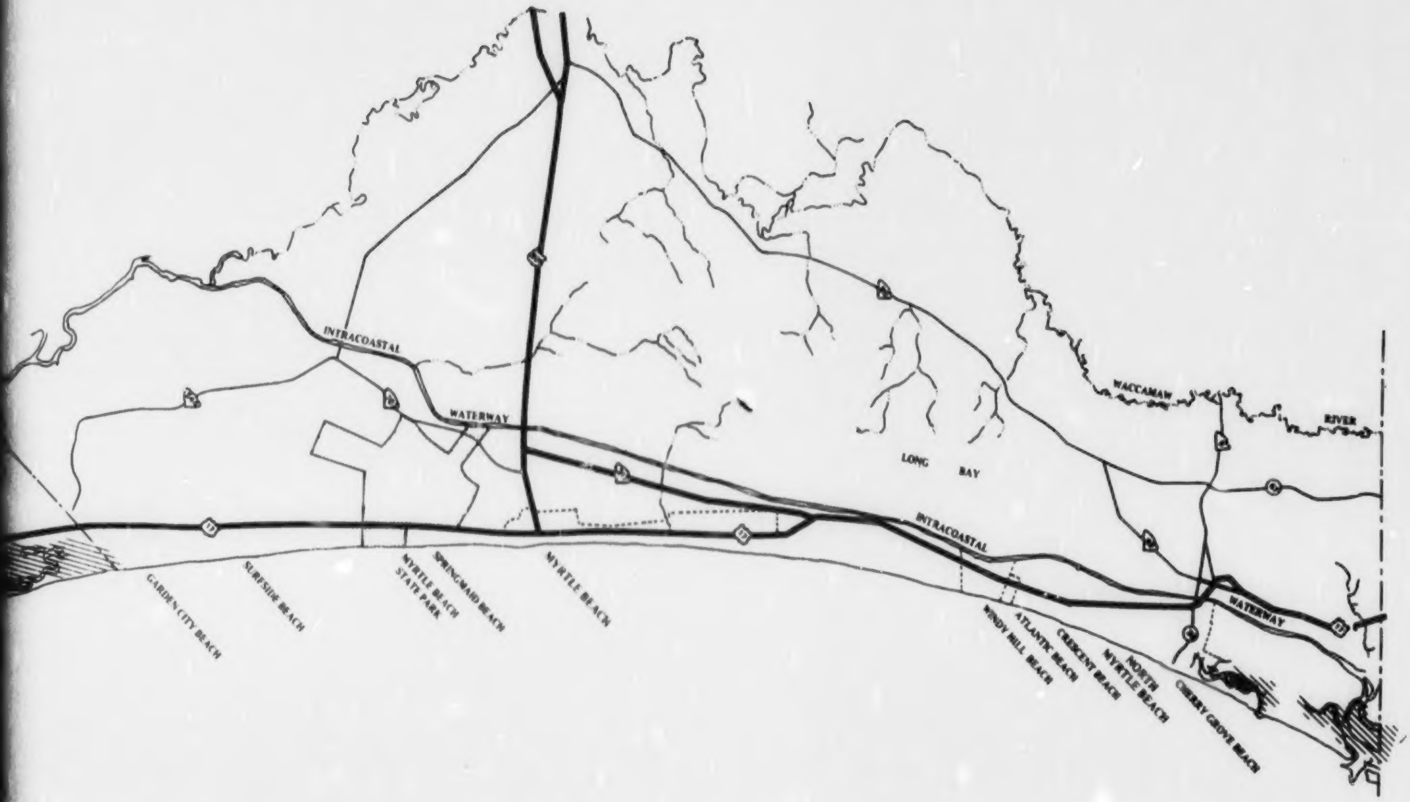
SANTEE BAY
ATLANTIC OCEAN
▨ MAJOR CLAM BED LOCATION

FIGURE 2-5
Nurseries for Shrimp, Clams, and Oysters (continued)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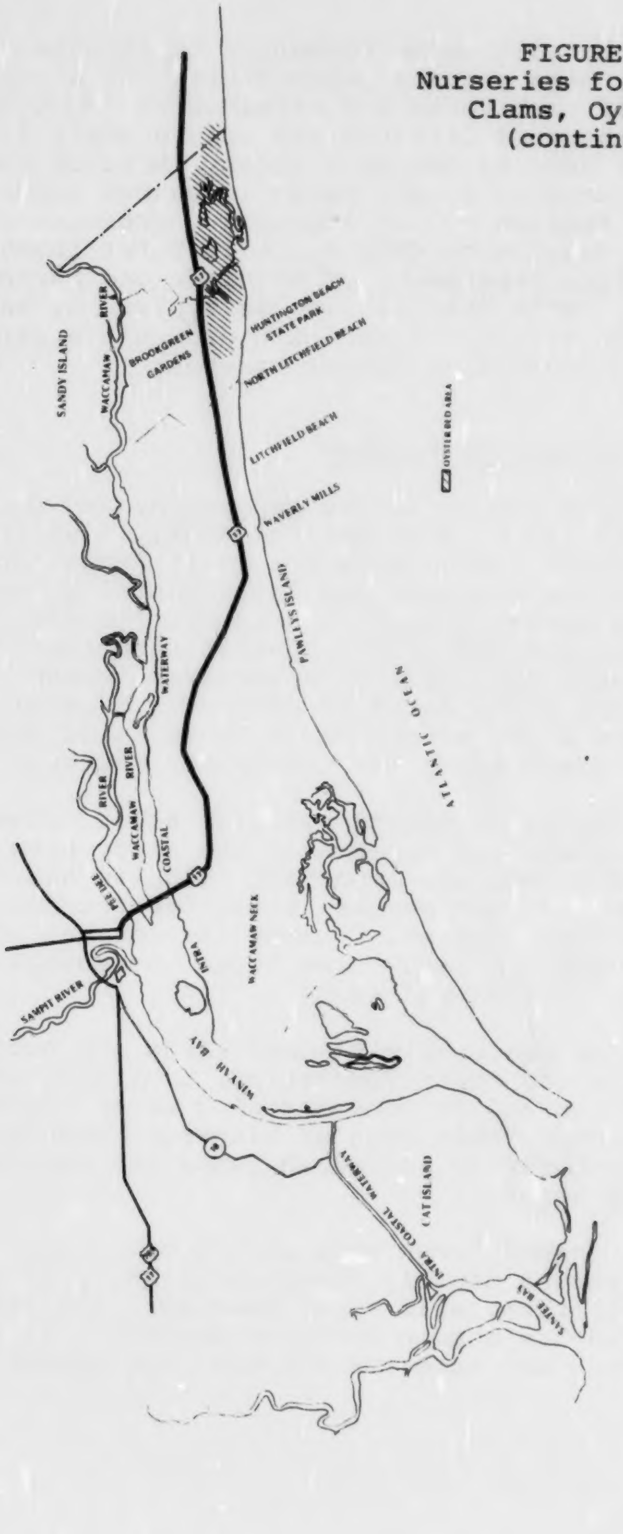
SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH

FIGURE 2-5
Nurseries for Shrimp,
Clams, Oysters
(continued)


SANDY ISLAND
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WAVERLY MILLS
PAWLEYS ISLAND
ATLANTIC OCEAN
OYSTER BED AREA
INTRA COASTAL WATERWAY
WACCAMAW RIVER
PEE DEE RIVER
WACCAMAW NECK
SAMPIT RIVER
WINYAH BAY
CAT ISLAND
INTRA COASTAL WATERWAY
SANTEE BAY
17

The salt marsh community represents an ecosystem with a very high primary productivity and a very low community component of herbivores and carnivores. Most of the primary production becomes detritus and only a small fraction of the detritus is used by the salt marsh. Most of the biological energy produced in a salt marsh is washed into estuaries as detritus. Section of Appendix presents a list of the salt marsh vegetation from Murrells Inlet inventoried by the South Carolina Department of Wildlife and Marine Resources in July, 1975. This species list is typical of saltwater marshes in the Grand Strand. Appendix B presents a list of common birds which inhabit saltwater marshes.

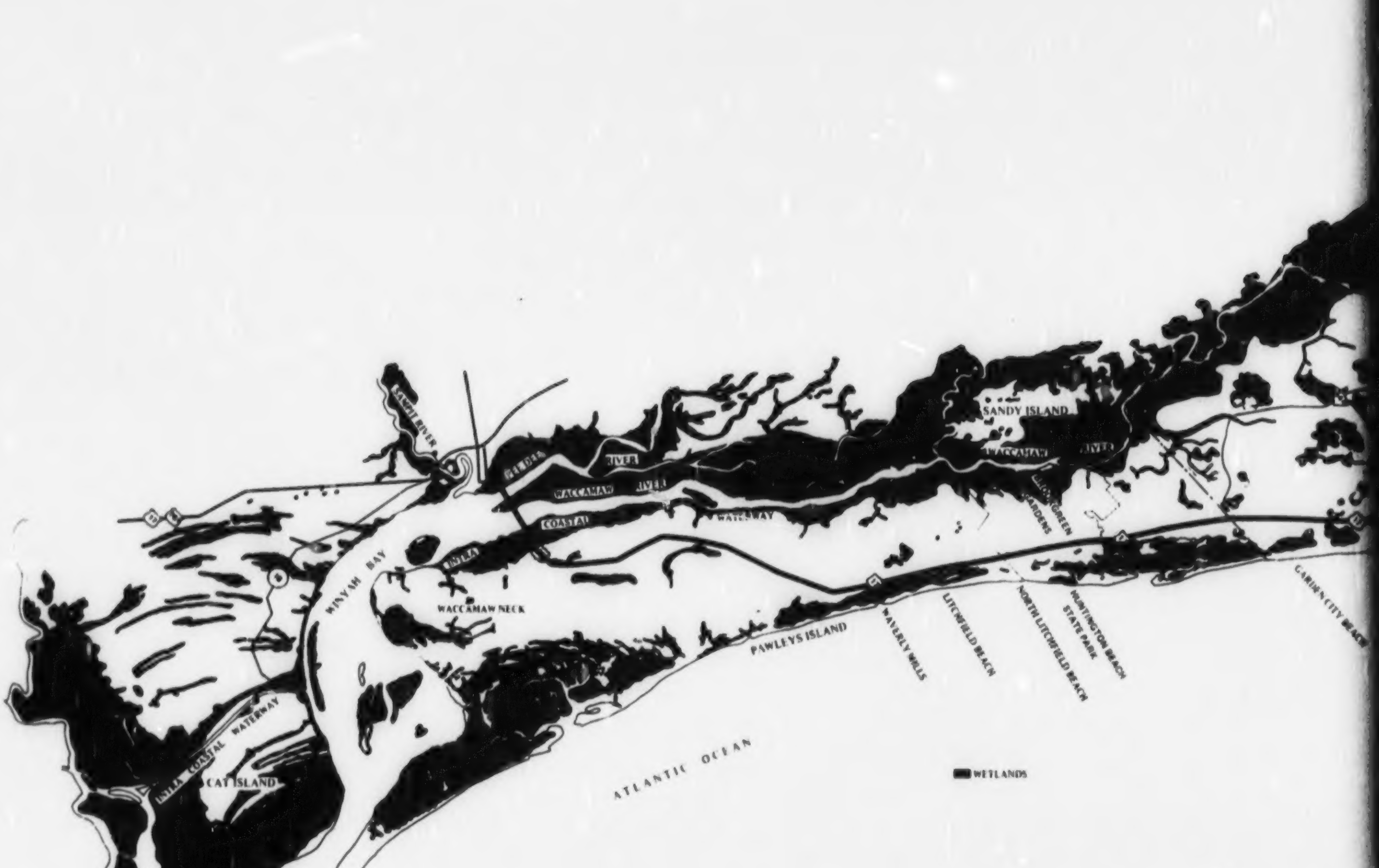
2.3.4. Freshwater Marshes

As a result of low topography and poor drainage, the Grand Strand has a large wetland area. A variety of wetland types are found inland from the coast along the Waccamaw River, and between the Waccamaw and Intracoastal Waterway. The types of wetlands include: Type 1, seasonal flooded basin; Type 7, wooded swamps; and Type 13, coastal deep fresh marshes. No extensive work has yet been undertaken to map these wetlands by type. The South Carolina Office of Coastal Zone Planning has provided a map of the marsh areas which was used for Figure 2-6 identifying the freshwater marshes.

The Grand Strand wetlands exist primarily as belts along the rivers and streams of the study area. These riparian marshes and swamps are important wildlife habitats and include spawning grounds and nursery areas for the numerous freshwater anadromous fish species. Swamps and marshes of the Grand Strand can be categorized into three types: seasonally flooded, coastal fresh marsh, and wooded swamp.

The seasonally flooded lands are subject to inundation which influences their vegetation, limiting them to mesophytic types that can endure some standing water around their root or crown systems. Trees such as blackgum, sweetgum, and ash are typical. Unforested, savannah lands are covered with various grasses and herbs.

Coastal fresh marshes support grass types of plants with some shrubs usually found on slightly drier hummocks. Cattail, bullrush, wild rice, sawgrass, alligator-weed, and pickerelweed are common emergent species. In this perennial wetland there are numerous floating and submersed plants.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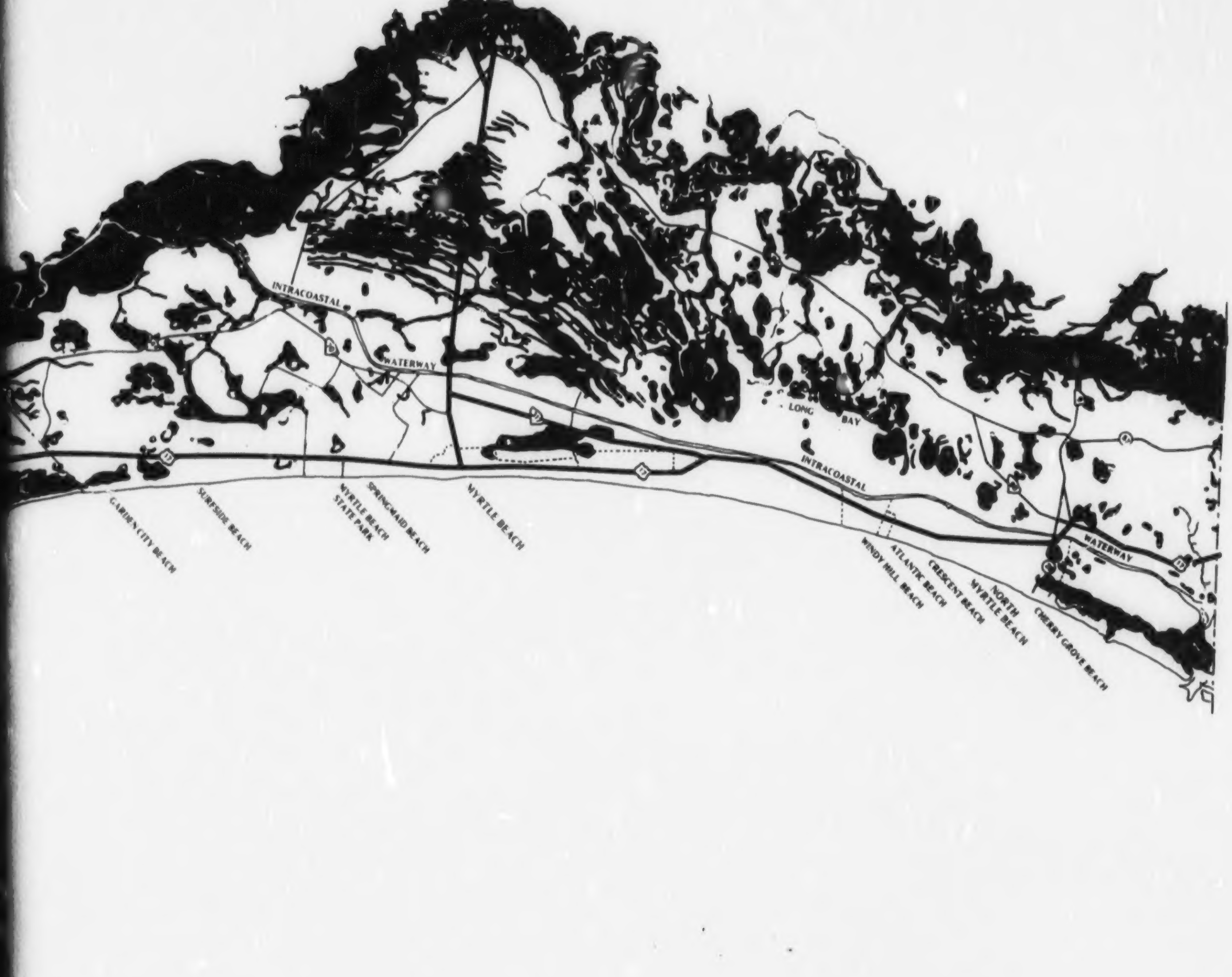
WACCAMAW NECK
PAWLEYS ISLAND
WAVERLY MILLS
LITCHFIELD BEACH
NORTH LITCHFIELD BEACH
HUNTINGTON BEACH STATE PARK
GARDEN CITY BEACH
17
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
WETLANDS

FIGURE 2-6
Freshwater Marshes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SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH

Rooted types with floating leaves are pondweeds, white waterlily, spatterdock, and watershield. Floating vegetation includes mosquito fern, duckweeds, bladderworts, and water-meal. Submersed species common to these marshes are bushy-pondweed, parrot-feather, coontail, and fanwort.

Wooded swamps are the most widespread and common wetland in the Grand Strand area. Typically, the trees in these swamps attain inordinately large size for their species. Several of the species were, in the past, sources of lumber and may still be. Cypress and swamp gums are probably the most characteristic tree species and the most spectacular in size and appearance. Other species common to this perennial wetland are water and swamp chestnut oaks, pond pine, red maple, sweetgum, waterash, and redbay. Although these species grow in water or on very wet sites, several of the latter species require some period of emergence of the soils around their root systems.

Wildlife typical of the marshes and wooded swamps includes several reptiles, most notably the American alligator. The birds of the fresh marsh are generally the same as the salt marsh with only a few exceptions. The clapper rail, endemic to the salt marsh, is replaced by the king rail. Also, the seaside sparrow is generally replaced by the swamp sparrow in the fresh marsh.

Exposures of mudflats in coastal fresh marshes are in response to tide cycles as are the salt marsh flats. These are the hunting grounds for the great variety of shore birds that frequent both marsh types. Herons and gulls also feed on the mudflats.

Mammals include the raccoon, muskrat, rice rat, and marsh rabbit.

2.3.5 Closed Shellfishing Areas

The regulation covering prohibited areas for the taking of shellfish states:

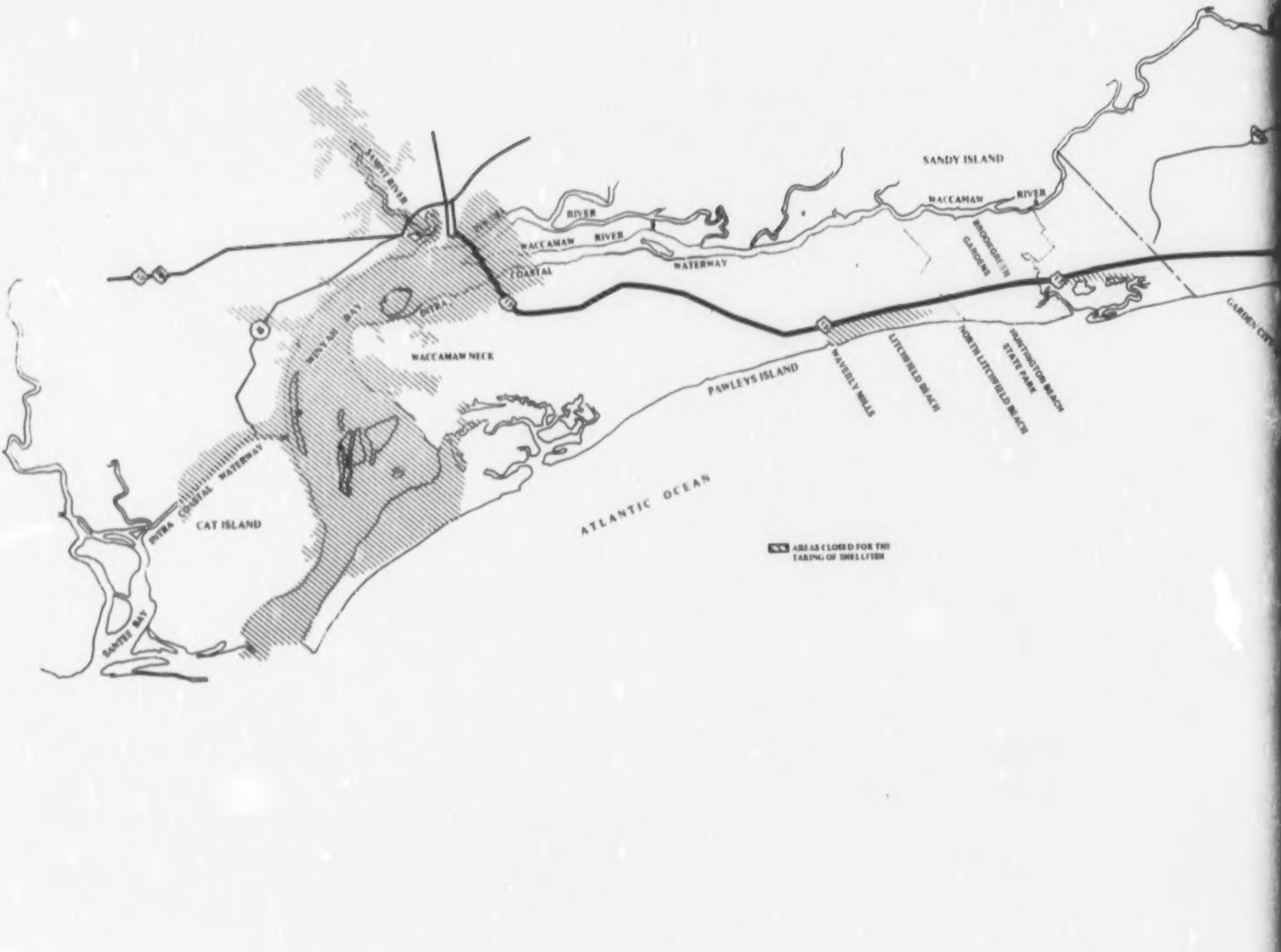
> "If the sanitary survey discloses that the area is either obviously subject to gross pollution by direct discharge of sewage and other wastes, or demonstrably exposed more or less continuously to even slight direct contamination with

> human fecal discharges, or if bacteriological examinations indicate that the degree of contamination is greater than that tolerated for moderately-polluted areas, then such area may be declared to be a grossly-polluted area from which the taking of shellfish for any purpose SHALL NOT BE PERMITTED."

The DHEC surveys the shellfishing areas on a biennial basis to determine whether the areas are grossly polluted and should be closed. The Prohibited Areas for the Taking of Shellfish (Revised September, 1974) lists the following areas on the Grand Strand as closed to shellfishing:

- All of Little River, as far as shellfish may grow, starting at Little River Inlet, including the Intracoastal Waterway to the North Carolina State Line, and parts of Dunn Sound to a point Southwest of the bridge to Waiters Island
- All of Midway Inlet up to the headwaters of the northern area of Midway Inlet
- All of Parsonage Creek to its conjunction with Allston Creek at Weston Flat at Murrells Inlet
- All of Winyah Bay extending north up the Waccamaw River to a point upstream of the U.S. 17 highway crossing including the southern portion of North Island
- Murrell's Inlet (open provisionally).

The closed shellfish areas are shown in Figure 2.7.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SANDY ISLAND
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BROOKGREEN GARDENS
WINYAH BAY
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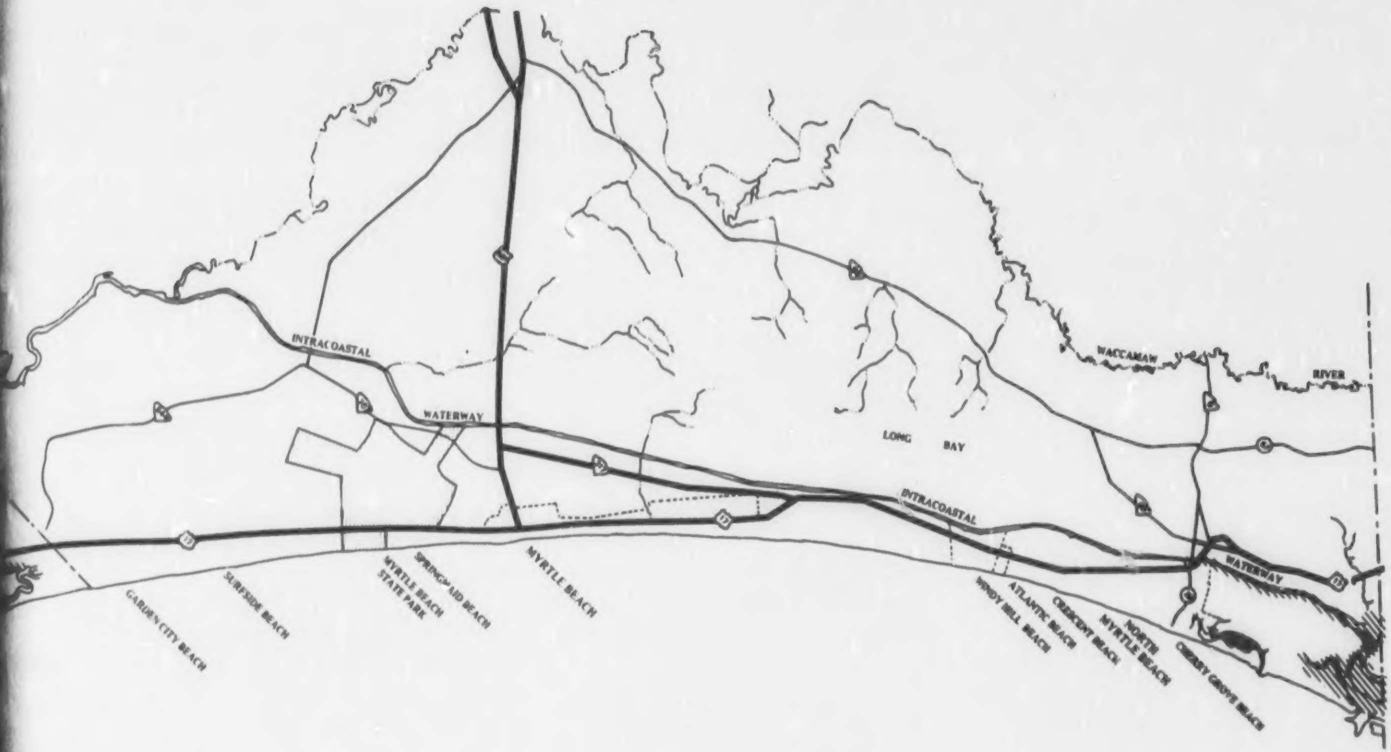
WACCAMAW NECK
PAWLEYS ISLAND
WAVERLY MILLS
LITCHFIELD BEACH
NORTH LITCHFIELD BEACH
HUNTINGTON BEACH STATE PARK
GARDEN CITY
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
17
AREAS CLOSED FOR THE TAKING OF SHELLFISH

FIGURE 2-7
Closed Shellfishing Areas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SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH

2.4 LAND FEATURES

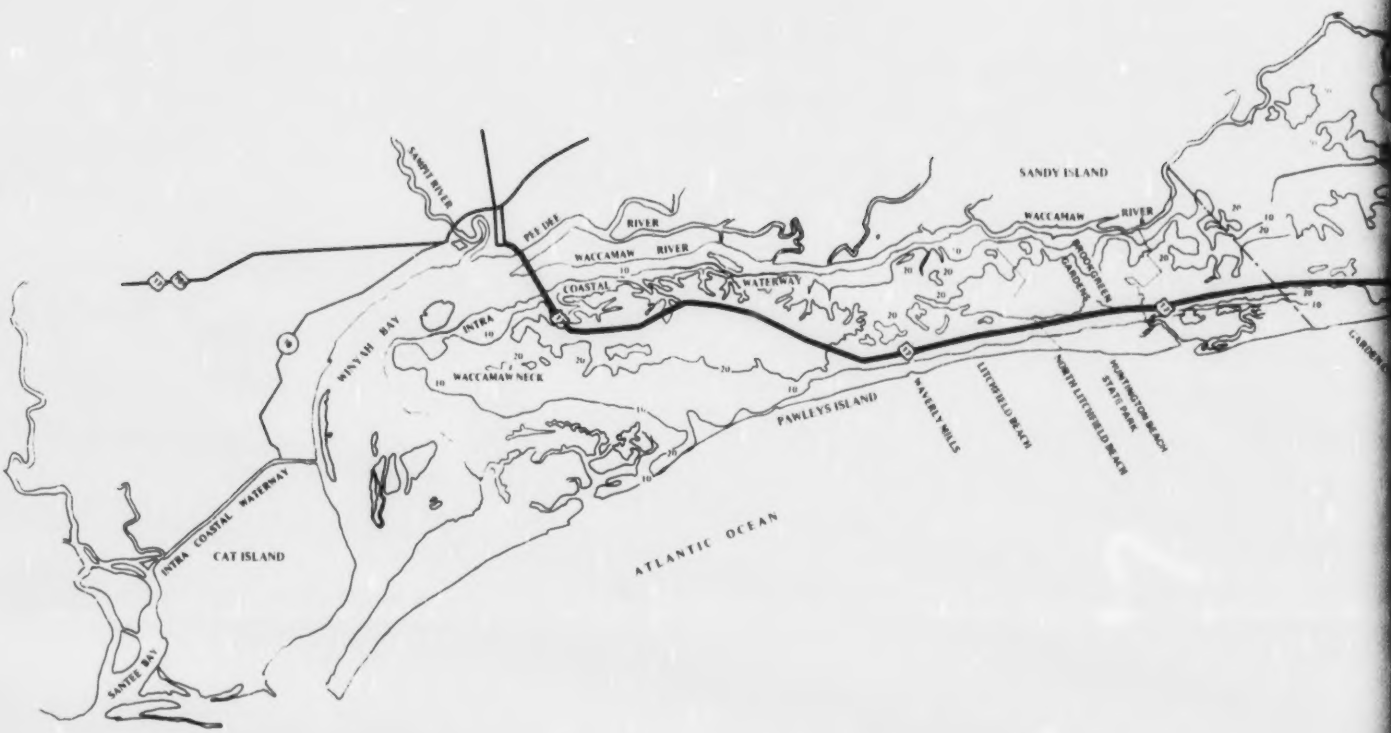
The purpose of this section is to provide the basis for determining whether the proposed wastewater treatment facilities are compatible with the region's land features. It is organized into the following sections:

- Topography
- Geology
- Soils
- Vegetation
- Wildlife.

2.4.1 Topography

The topographic features of the Grand Strand planning region are generally level to gently sloping terrain with elevations ranging from sea level to about 50 feet. The majority of the northern sector between the Waccamaw River and the Intracoastal Waterway north of Myrtle Beach Air Force Base is at an elevation of 25 feet. The planning region's highest elevation of about 50 feet is located in this section and covers a small area WSW of the Atlantic Beach community. Small stretches of 25 foot elevation terrain occur along the coast between the Atlantic Ocean and Intracoastal Waterway down to the community of Myrtle Beach. Other 25 foot elevation stretches are located SSW of the Air Force Base and SW of Pawley's Island. Figure 2-8 illustrates the major topographic contours of the Grand Strand planning region just described and also provides the general drainage patterns within the region. In addition, the figure shows the location of the three proposed sites for wastewater treatment plants (WWTP) which have been designated as WWTP-A, -C, and -G and have elevations of 45, 15 and 25 feet, respectively.

The drainage patterns within the planning region are influenced by a network of natural and man-made streams or canals as well as the Atlantic Ocean. Overall, the entire Waccamaw region is in the Pee Dee River Basin and the drainage within the basin tends to traverse southeasterly towards the major rivers and streams, their tributaries, the Intracoastal Waterway, and ultimately, the Atlantic Ocean. For the Grand Strand region, the drainage pattern is northwesterly to the Waccamaw River in addition to following the Basin's southeasterly tendency. The drainage patterns of the proposed WWTP sites differ significantly from one another. Site WWTP-A drainage is expected to traverse toward the Intracoastal Waterway, while Site WWTP-C drainage flows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RIVER
WACCAMAW RIVER
SANDY ISLAND
WACCAMAW RIVER
BROOKGREEN GARDENS
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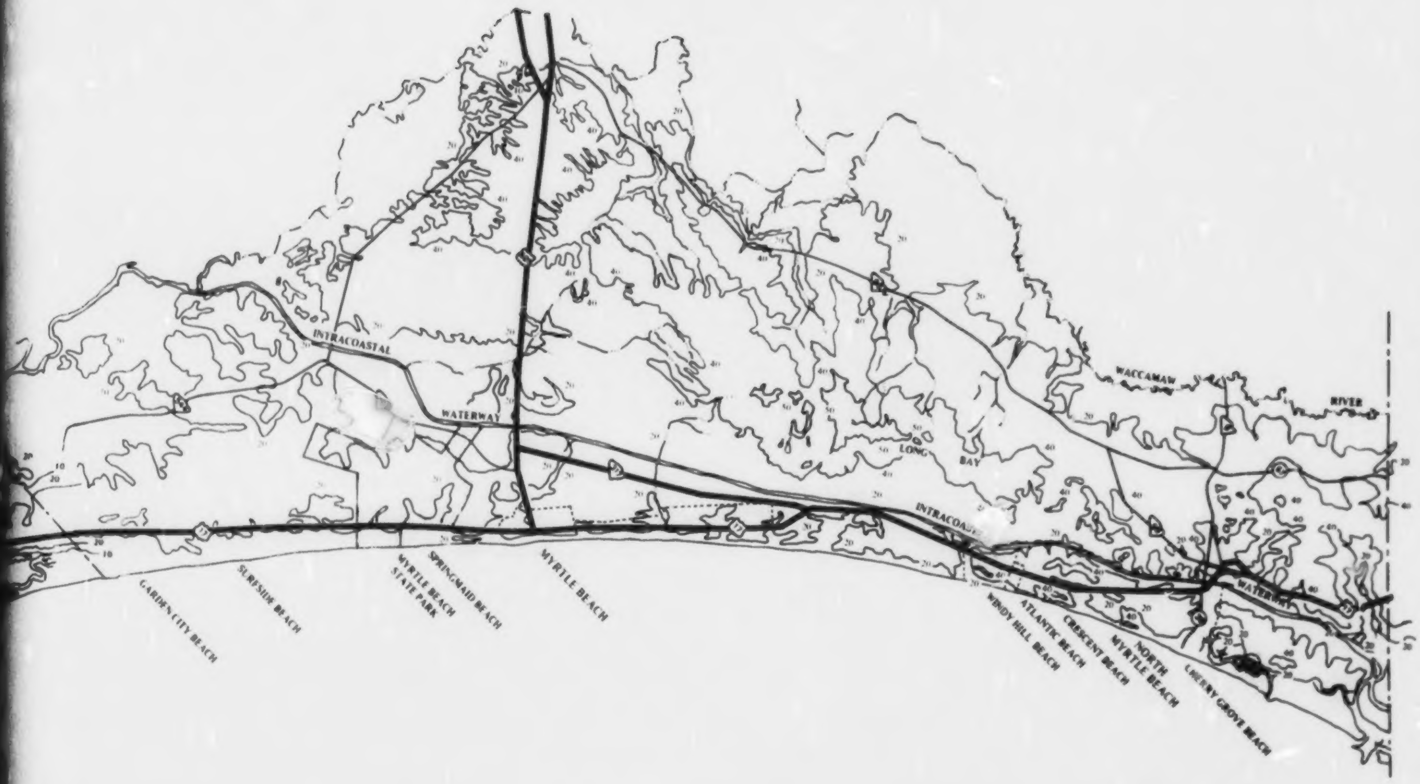
WATERWAY
WINYAH BAY
WACCAMAW NECK
PAWLEYS ISLAND
WAVERLY MILLS
LITCHFIELD BEACH
NORTH LITCHFIELD BEACH
HUNTINGTON BEACH STATE PARK
GARDEN C
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
10
20

FIGURE 2-8
Topography and Drainage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STATE PARK
SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH
MYRTLE BEACH
CHERRY GROVE BEACH
10
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50

toward the Waccamaw River and the Atlantic Ocean. Drainage from site WWTP-G is likely to flow only toward the Waccamaw River.

2.4.2 Geology

The purpose of this section is to determine whether the area provides a suitable foundation for surface soils, is suitable for supporting various waste disposal options, and is resistant to pollutants permeating surface soils. The composition of the major geologic formations, the location of major aquifers and the probable occurrence of significant earth movements in the area are well established.

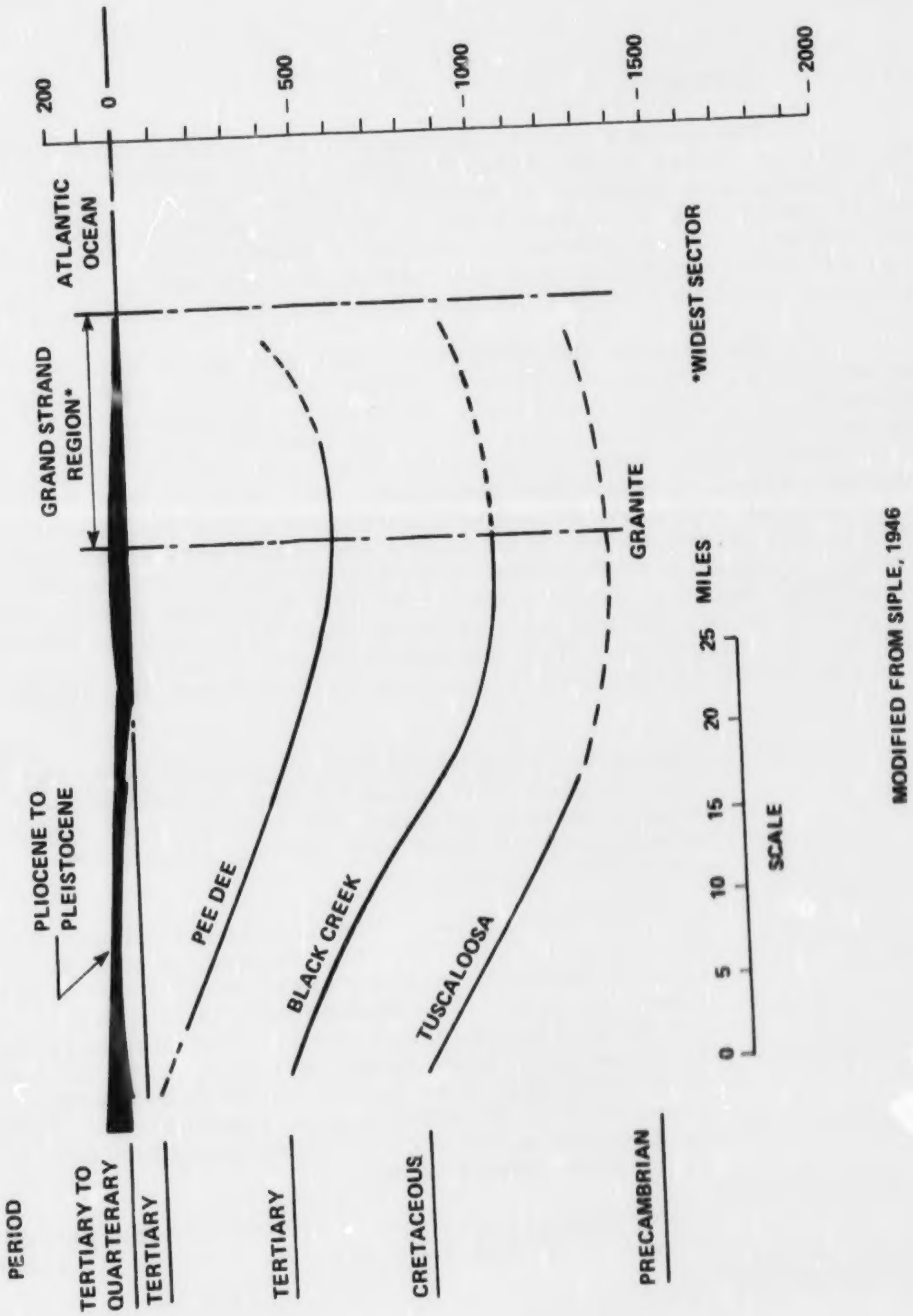
The geological structure and the major geologic formations of the Grand Strand region are relatively simple: sedimentary (loose, settleable material) formations with depths ranging from a total of 1,100 feet to 1,290 feet below sea level. These formations have been designated as follows, starting with the uppermost formation: The Pliocene-Pleistocene-recent deposit formation, the Pee Dee formation, the Black Creek formation, and the Tuscaloosa formation. Figure 2-9 provides a geologic cross section at the widest portion (Myrtle Beach to the Waccamaw River) of the planning region and illustrates the relationship between each major formation. The composition and physical characteristics of these formations can be described briefly as:

- Pliocene, Pleistocene, and Recent Deposits. The average thickness of the formation is approximately 80 feet and consists of varying coarseness of sand and gravel intermixed with clay.

- Pee Dee Formation. The thickness ranges from 300 to 600 feet, and the formation exists as a thin layer in the northern part of the region and gradually widens to its thickest point in the southern part. The composition is fine to coarse sands and dark gray to tan gray hard and soft marls (clay mixed with limestone). A water-table (unconfined) aquifer is located within this formation at about 50 feet below the surface.

- Black Creek Formation. The thickness varies from 400 to 600 feet with an average of about 570

FIGURE 2-9
Geologic Cross Section
Grand Strand Region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GRAND STRAND REGION*
PLIOCENE TO PLEISTOCENE
PEE DEE
BLACK CREEK
TUSCALOOSA
GRANITE
*WIDEST SECTOR
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10
15
20
25
MILES
SCALE
MODIFIED FROM SIPLE, 1946
PERIOD
TERTIARY TO QUARTERARY
TERTIARY
TERTIARY
CRETACEOUS
PRECAMBRIAN

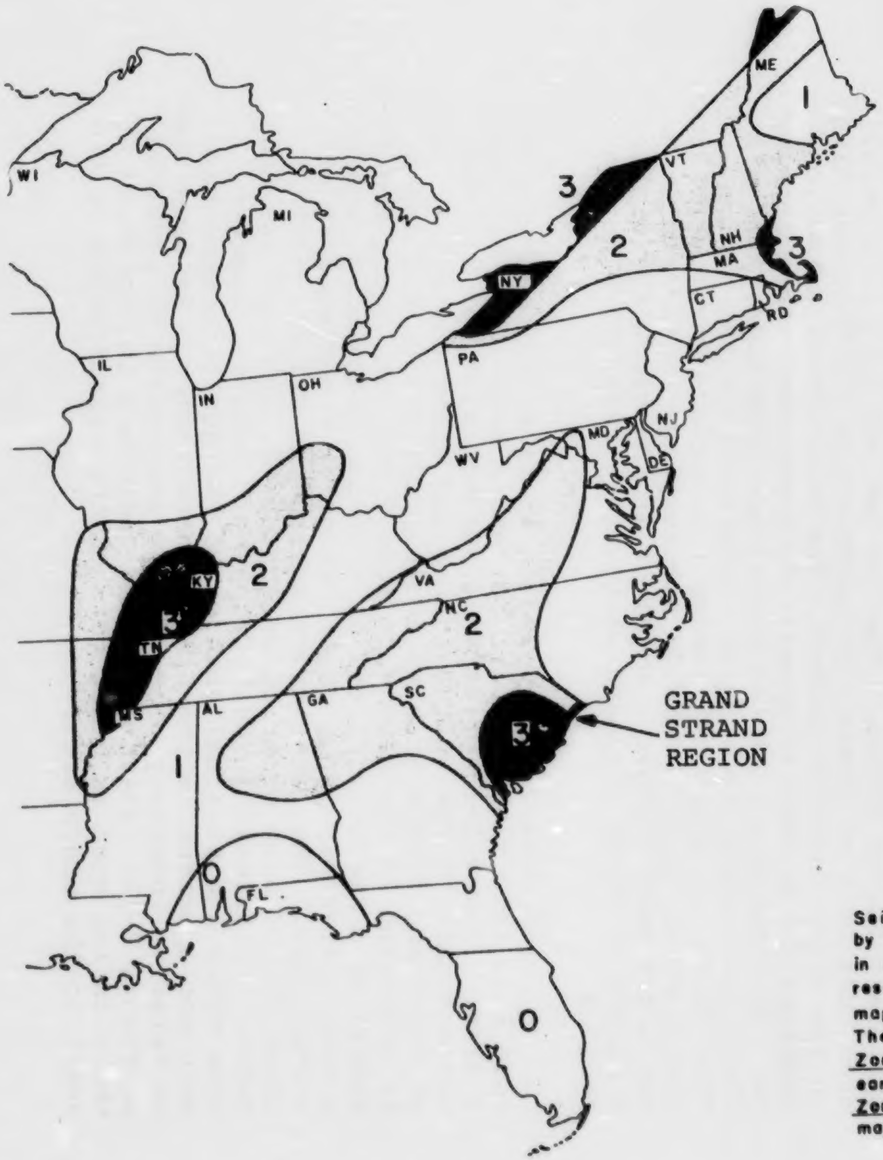
feet. The formation consists of a dark, brownish-black-gray laminated clay and fine sand material which has a shale type appearance. The Pee Dee Black Creek aquifer lies within this formation, just below the water-table aquifer.

- Tuscaloosa Formation. This formation varies approximately 300 to 400 feet in thickness and consists of light-gray, tan, red, and purple mixture of sands, clays, and kaolin (a form of clay). Within this formation, the Tuscaloosa aquifer is confined under artesian conditions and lies below the Pee Dee Black Creek aquifer.

Outcroppings (surfacing of the geologic formations), in general, occur only in a few isolated locations within the Grand Strand region. The Pee Dee outcrops in a small area just west of Conway and north along the Waccamaw River to the North Carolina border. The Black Creek formation outcrops in an area northeast of Conway near state highway 90. No outcropping of the Tuscaloosa formation, which is the bottom sedimentary layer, occurs within the region. This formation stays well below the surface layer throughout the planning area. Overall, outcroppings in the region do not occur near (within 1 mile) or in the vicinity (within 5 miles) of three proposed wastewater treatment plant locations.

The Grand Strand region is in a medium-level or zone 2 seismic risk area and borders a high-level or zone 3 area. Figure 2-10 presents a seismic risk map for the eastern half of the United States and shows the relationship of the Grand Strand area to the various designated zones. As indicated in the figure, a zone 2 area may incur moderate damage as a result of local or distant earthquakes, whereas a zone 3 area may incur major damage or experience major earthquakes. The last severe earthquake affecting the Grand Strand area occurred on August 31, 1886 and was centered in Charleston, South Carolina. Damages, however, were minor and physical changes to the geologic structure were not apparent in the Grand Strand region. An isoseismal or relative intensity plot of this earthquake is provided as Figure 2-11. The figure also indicates the location of the planning area in order to show the relationship of the event to the study area.

FIGURE 2-10
Seismic Risk Map of the U.S.


WI
MI
IL
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OH
PA
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NH
MA
CT
RD
NJ
DE
MD
WV
VA
NC
KY
TN
MS
AL
GA
SC
FL
1
2
3
3
2
3
2
3
2
1
3
1
0
0
GRAND
STRAND
REGION

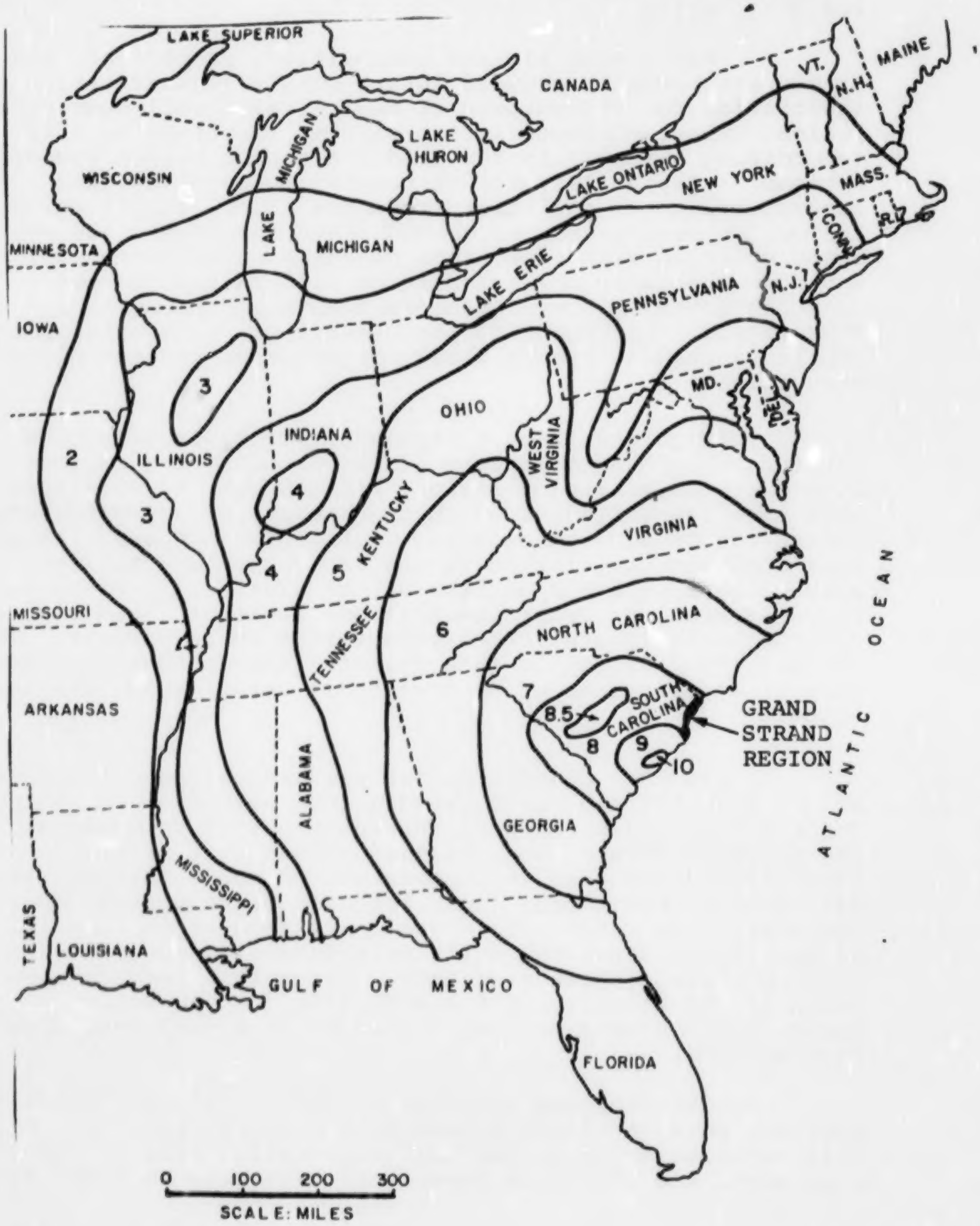
LEGEND

DAMAGE

0 - NONE
☐ 1 - MINOR
▨ 2 - MODERATE
■ 3 - MAJOR

Seismic risk map for conterminous U.S., developed by ESSA/Coast and Geodetic Survey and issued in January 1969. Subject to revision as continuing research warrants, it is an updated edition of the map first published in 1948 and revised in 1951. The map divides the U.S. into four zones: Zone 0, areas with no reasonable expectancy of earthquake damage; Zone 1, expected minor damage; Zone 2, expected moderate damage; Zone 3, where major destructive earthquakes may occur.

FIGURE 2-11
Dutton's Isoseismals of the 1886
Charleston Earthquake
Rossi-Forel Scale


LAKE SUPERIOR
CANADA
LAKE MICHIGAN
LAKE HURON
WISCONSIN
LAKE ONTARIO
NEW YORK
VT.
N.H.
MAINE
MASS.
CONN.
R.I.
MINNESOTA
MICHIGAN
LAKE ERIE
PENNSYLVANIA
N.J.
IOWA
3
MD.
DEL.
OHIO
INDIANA
WEST VIRGINIA
2
ILLINOIS
4
3
KENTUCKY
VIRGINIA
4
5
MISSOURI
TENNESSEE
6
NORTH CAROLINA
ATLANTIC OCEAN
ARKANSAS
7
8.5
SOUTH CAROLINA
GRAND STRAND REGION
8
9
10
ALABAMA
GEORGIA
MISSISSIPPI
TEXAS
LOUISIANA
GULF OF MEXICO
FLORIDA
0 100 200 300
SCALE: MILES

2.4.3 Soils

Soils with similar composition, properties, and origin are normally grouped into a single classification or association for the purpose of generalizing soil characteristics. These characteristics play an important role in determining suitability for land and septic system disposal options, acceptability for structural foundations, and susceptibility to pollutant transport (i.e., infiltration/inflow, or percolation to ground water supplies). As an example, soils with poor drainage (high water retention) and noncompactable characteristics will have rapid percolation rates and very unstable foundation properties. These soils, therefore, can be classified as unsuitable for septic tanks, conveyance lines, or other wastewater processing structures.

Figure 2-12 is a regional soil map showing the particular soil associations of the Grand Strand region. Within the Grand Strand region, fifteen soil associations have been identified of which four represent approximately two-thirds or 270 square miles of the planning area. The most dominant association is the St. Johns-Leon-Rutlege which covers about 23 percent of the area, followed by the Bladen-Weston and Swamp associations at about 16 percent each, and the Wando-Coastal Beach association at 12 percent. The suitability (for septic tank disposal and foundations) and general descriptions of each of these associations are listed below.

The St. Johns-Leon-Rutlege association, designated at No. 4 on the map, is located in the northern part of the Grand Strand region between the Intracoastal Waterway and the Waccamaw River. The proposed WWTP-A site is within this association area which consists of soils that are very dark gray to black fine sand, cemented or compacted sand, and loamy fine sand. The overall drainage of these soils is very poor, since the soils were developed or originated from moderately thick sand beds. Three test borings were taken in the vicinity of the WWTP site and the soil type found varied from a sand-silt mixture to a sand-with organic silt mixture.

The proposed location of WWTP-G is just inside the southern portion of the Bladen-Weston association (No. 5). This association is in the northern central area of the planning area, and the soils consist of dark gray to black fine

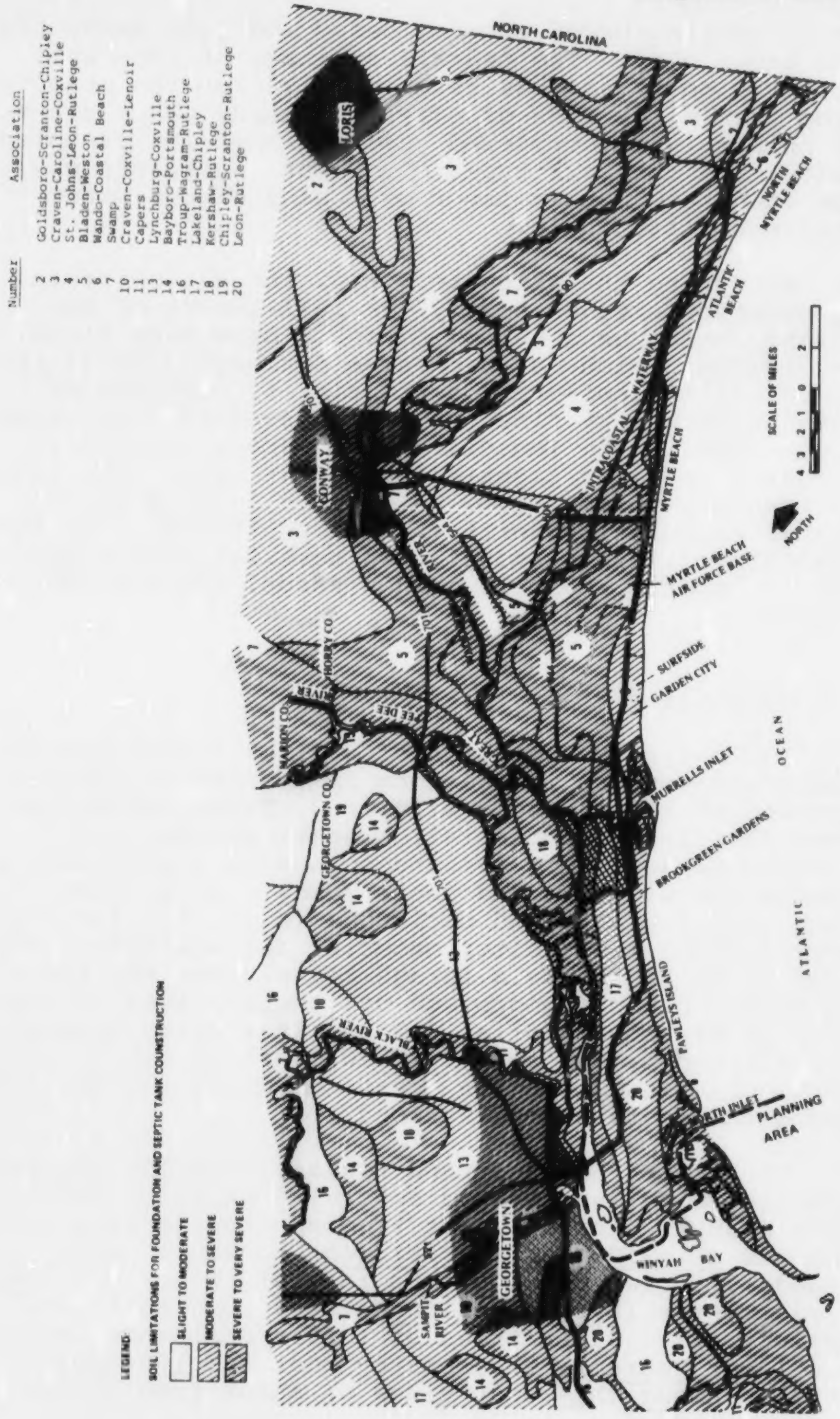


FIGURE 2-12
Regional Soil Map

Number Association
2 Goldsboro-Scranton-Chipley
3 Craven-Caroline-Coxville
4 St. Johns-Leon-Rutlege
5 Bladen-Weston
6 Wando-Coastal Beach
7 Swamp
10 Craven-Coxville-Lenoir
11 Capers
13 Lynchburg-Coxville
14 Bayboro-Portsmouth
16 Troup-Wagram-Rutlege
17 Lakeland-Chipley
18 Kershaw-Rutlege
19 Chipley-Scranton-Rutlege
20 Leon-Rutlege
LEGEND:
SOIL LIMITATIONS FOR FOUNDATION AND SEPTIC TANK COUNSTRUCTION
SLIGHT TO MODERATE
MODERATE TO SEVERE
SEVERE TO VERY SEVERE
NORTH CAROLINA
LORIS
CONWAY
HORRY CO
MARION CO
GEORGETOWN CO
GEORGETOWN
PEE DEE RIVER
BLACK RIVER
SAMPIT RIVER
INTRACOASTAL WATERWAY
NORTH MYRTLE BEACH
ATLANTIC BEACH
MYRTLE BEACH
MYRTLE BEACH AIR FORCE BASE
SURFSIDE
GARDEN CITY
MURRELLS INLET
BROOKGREEN GARDENS
PAWLEYS ISLAND
NORTH INLET
PLANNING AREA
WINYAH BAY
ATLANTIC OCEAN
SCALE OF MILES
4 3 2 1 0 2
NORTH

sandy loam, grayish-brown to gray heavy and fine sandy clay loam, and brown clay. The overall drainage of this soil association is poor and results primarily from the association's derivation from thick beds of clays and heavy sandy clays. Two test borings were completed just south of the proposed WWTP-G site, and the soil types found were inorganic clay, clay type sand, and a thin layer of a sand silt mixture at the southernmost test hole.

Bordering the Atlantic Ocean, the Wando-Coastal beach association extends nearly the full length of the Grand Strand region as a narrow 1 to 2.5 mile wide strip. This association, which has excessive drainage (little or no water retention) and erosion properties, consists of soils ranging from very fine gray-brown sand to fine brown subsoil-type sand. The immediate beach areas consist of varying coarsenesses of light brown to tan sand. The third proposed treatment plant site, WWTP-C, is located on this type of soil association north of Pawleys Island. Ten test borings within this soil association revealed soil types of sand silt, poorly and well graded sands, and sand with organic silt.

2.4.4 Vegetation

The natural vegetation of a given region provides subsistence and support in one form or another to sustain the existence of the region's wildlife. Trees, woody and herbaceous (leafly and perennial) plants, shrubs, and grasses yield natural food resources, shelter, and nesting environments for wildlife and their young. As an example, coniferous (e.g., pines) and deciduous (e.g., oak and maple) trees provide food and shelter material for wildlife. Many species of birds and mammals forage these trees for their seeds or tender branch shoots and use their leaves or needles as shelter or nesting material. Thus, if a large vegetated area is disturbed by man's activities, such as urbanization and clearing cutting, then the area's wildlife and delicate ecosystem balance are also disturbed.

Within the Grand Strand region, over 150 species of vegetation exist and include several species of rare or infrequent plants. The dominant tree species in this region are sweet gum (Liquidambar styraciflua), Loblolly pine (Pinus taeda), turkey oak (Quercus laevis), water oak (Quercus nigra), wax myrtle (Myrica cerifera), and long leaf pine (Pinus palustris). Other trees of lesser dominance include red maple (Acer rubrum), and scrubby post oak (Quercus margaretta). Among the woody vines or shrub type plants within the Grand Strand region, the common species are sassafras (*Sassafras albidum*), fetterbush (*Lyonia lucida*), yellow jessamine or jasmine (*Gelsemium sempervirens*), and rhododendron (*Rhododendron canescens*). Herbaceous plants, which are perennial leaf-type vegetation, found to be common in the planning region, include broom sedge (*Andropogon virginicus*), stinging nettle (*Cnidosculum stimulosus*), cud weed (*Gnaphalum purpureum*), and thistle (*Circium canadensis*). Along the roads and highways and in open fields or meadows, many species of undefinable grasses and weeds exist. A few of the known species within the region, however, are pepper grass (*Lepidium virginicum*), rag weed (*Ambrosia artemisifolia*), dandelion (*Taraxicum officinale*), plume grass (*Erianthus giganteus*), star grass (*Helenium flexuosum*), and fire weed (*Erechtites hieracifolia*). Rare or infrequent species occur in very small numbers and/or grow in very restricted areas or specialized environments within the Grand Strand region. Although a particular rare or infrequent plant may not be under an immediate threat of extinction, special care may be required to prevent damage or adverse effects. The species found in the planning region, but not within any of the three proposed WWTP sites, include the rosebud orchid (*Cleistes divaricata*), rose pogonia (*Pogonia ophioglossoides*), and hooded pitcher plant (*Sarracenia minor*). All three tropical type species grow in relative abundance in a heavily moist area bout 1.5 miles west of the Intracoastal Waterway near state highway 501 and have been listed* as rare or infrequent in the coastal plains (eastern).

Farmlands grow such commercial crops as tobacco, corn, and soybeans. Details on the annual harvest and assessed valuation of these crops are presented in the Man-Made Environment Chapter of the EIS. Open space or open field sectors within the planning region are predominantly grasses or low growing vegetation with very few trees. Forestlands are divided into three categories:

- Coniferous forestland (evergreens)
- Mixed forestland
- Deciduous forestland (leaf-shedding).

In the coniferous forestland category, pines are the dominant tree species and include: loblolly, longleaf, shortleaf, pond, and virginia. The deciduous forestland consists mostly of such species as maples, oaks, gums, dogwoods, and other leaf-shedding species. The mixed forestland is a combination of deciduous and coniferous trees which are distributed somewhat evenly throughout the category area.

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* Radford et al, "Vascular Flora of the Carolinas," 1964.

2.4.5 Wildlife

A large variety of terrestrial wildlife can be found within the Grand Strand region, including common and rare or endangered species of birds, mammals, and reptiles. Over 100 species have been sighted to date and many of these species are established residents, utilizing the numerous types of habitats created by the region's natural vegetation. As indicated in the "Vegetation" section, wildlife rely on these habitats for support and subsistence, and any major alteration to their environment by man's activities will result in a corresponding threat to their existence. Migratory wildlife species, predominantly birds, are also affected by major habitat alteration but with less severity, providing that a compatible habitat area nearby is readily accessible. Generally, migratory wildlife may use a particular habitat or vegetated area for nesting or breeding purposes as well as for food resources and temporary shelter. In the Grand Strand planning region, a large number of birds migrate to the region every spring and the migration is considered to be one of the largest in the continental United States.

The relationship of the Grand Strand region's wildlife population to the region's existing vegetation is outlined in Table 2-9, which divides the various species into three habitat categories: overstory (trees) dwellings, understory (shrubs) or surface dwellings, and subsurface or subterranean dwellings. In addition, the table includes an index of each species' dietary habits (carnivorous, omnivorous, etc.) and a brief summary of its food resources or diet to provide an overview of wildlife-vegetation interdependency. The wildlife listed represents a sampling of the major terrestial species believed to be associated with the Grand Strand planning region.

Table 2-9
Terrestrial Wildlife Associated with the Grand Strand Planning Region (Supplemental information being developed)

Wildlife Type	Overstory Habitat	Dietary Habit	Food Resources or Diet
Mammals			
Fox Squirrel		Herbivorous	Tree fruits, plant buds, tree bark
Gray Squirrel		Herbivorous	Largely plant material
Southern Flying Squirrel		Omnivorous	Seeds, nuts, insects, bird eggs, meat
Several species of Bats		Insectivorous	Insects, moths, beetles
Birds			
Hawks		Carnivorous	Mice, rabbits, snakes
Owls		Carnivorous	Small mammals, insects
Warblers		Insectivorous	Insects
Carolina Wren		Insectivorous	Insects, seeds
Cardinal		Herbivorous	Seeds, fruit, grain, plants
Red-cockaded Woodpecker*		Omnivorous	Insects, berries
Pileated Woodpecker		Omnivorous	Insects, berries
Mockingbird		Insectivorous	Insects, spiders, fuits
Thrushes		Omnivorous	Insects, moths, larvae, berries
Robin		Insectivorous	Insects, worms
Summer Tanager		Insectivorous	Insects
Flycatchers		Insectivorous	Insects
Vireos		Insectivorous	Insects, worms
Waxwings		Omnivorous	Insects, fruits, worms
Southern Bald Eagle*		Carnivorous	Small mammals
Osprey or Fish Hawk*		Carnivorous	Fish

* Rare or endangered species.

Table 2-10 (continued)

Wildlife Type	Understory or Surface Habitat	Dietary Habit	Food Resources or Diet
Mammals			
Black Bear*		Omnivorous	Small mammals, plants, berries, nuts
Eastern Cottontail		Herbivorous	Green vegetation, bark, twigs
Marsh Rabbit		Herbivorous	Marsh vegetation
Whitetail Deer		Herbivorous	Twigs, shrubs, fungi, acorns, grass
Rice Rat		Herbivorous	Green vegetation and seeds
Eastern Woodrat		Herbivorous	Seeds, nuts and fruits
Golden Mouse		Herbivorous	Seeds, nuts and fruits
Cotton Mouse		Herbivorous	Seeds and insects
Gray Fox		Omnivorous	Small mammals, fruits, eggs, acorns
Bobcat or Wildcat		Carnivorous	Small mammals, birds
Striped Skunk		Omnivorous	Mice, Eggs, grubs, berries
River Otter		Carnivorous	Small aquatic animals
Mink		Carnivorous	Small mammals, eggs, fish, frogs, birds
Longtail Weasel		Carnivorous	Small mammals, birds
Raccoon		Omnivorous	Fruits, nuts, frogs, grains, eggs
Opossum		Omnivorous	Fruits, nuts, meat, eggs, insects
Birds			
Snowy Owl		Carnivorous	Small mammals
Mourning Dove		Herbivorous	Grains, seeds, grasses
Woodcock		Insectivorous	Worms, insects
Snipe		Omnivorous	Small animals, plants
Brown Thrasher		Insectivorous	Insects, spiders, worms
Water Turkey		Carnivorous	Fish and other aquatic animals
Sparrows		Insectivorous	Insects, worms, seeds, lice
Meadow Lark		Insectivorous	Insects, seeds
Red-winged Blackbird		Insectivorous	Insects, worms
Reptiles			
Various species of Snakes		Carnivorous	Small mammals, eggs
American Alligator**		Carnivorous	Small mammals, aquatic animals

* Almost non-existent except in wildlife preserve.

** Rare or endangered species.

Table 2-10 (continued)

Wildlife Type	Subsurface Habitat	Dietary Habitat	Food Resource or Diet
Mammals			
Pine Vole		Herbivorous	Roots, bulbs, tubers, seeds
Meadow Vole		Herbivorous	Grasses, sedges, seeds, grain, bark
Eastern Mole		Herbivorous	Vegetables, roots, insects, worms
Shorttail Shrew		Carnivorous	Invertebrates, mice
Least Shrew		Carnivorous	Insects, small animals
Reptiles			
Several species of Snakes		Carnivorous	Small mammals, eggs
Lizards		Insectivorous	Insects

The existence of many species of wildlife in the United States have been seriously threatened by man's activities. Alteration or removal of essential life support systems within habitats and/or environments are the result of these activities. Man, unfortunately, did not provide any viable alternatives for these species. The Congress, in an attempt to save these threatened species, enacted the Endangered Species Act (Public Law 93-205; 87 Stat. 884) in December of 1973 which replaced the previous Endangered Species Conservation Act of 1969 (Public Law 91-135). The Act basically protects and classifies the threatened species and provides the following standard definition of terms:

- Endangered. Actively threatened with extinction, continued survival unlikely without the implementation of special protective mitigative measures.

- Rare. Not under immediate threat of extinction, but occurring in such small numbers and/or in such restricted or specialized habitats.

- Depleted. Although occurring in numbers sufficient for survival, the species has been heavily depleted and continues to decline at a rate, exceeding their regenerative capabilities.

- Indeterminate. Apparently threatened but insufficient data currently available on which to base a reliable assessment of status.

Several rare and/or endangered species of wildlife could possibly be inhabiting or have been sighted within the Coastal Zone of South Carolina. Since the Grand Strand region is a part of this zone, endangered species may also be present in various parts of the region. These species, specifically, include:

- Birds. Southern bald eagle (Haliaeetus leucocephalus leucocephalus), Brown pelican (Pelecanus occidentalis), Red-cockaded woodpecker (Dendrocopus borealis), Bachman's warbler (Vermivora bachmanii), American peregrine falcon (Falco peregrinus anatum), Ivory billed woodpecker (Campephilus principalis), and Kirtland's warbler (Dendroica kirtlandii).

- Mammals. Eastern cougar (Felis concolor) and Florida manatee (Trichechus manatus latirostris).

- Reptiles. American alligator (Alligator mississipiensis).

2.5 ATMOSPHERE

2.5.1 Climate

The climate of the area is of the maritime tropical type, which provides extended tourist and agricultural seasons, and is strongly influenced by the Atlantic Ocean. Its moderating effect tends to prevent extremes of temperature, making winters and summers mild. Sea breezes, which normally begin before noon and continue until late afternoon, help to cool the rapidly heated land during the summer.

Generally, prevailing winds are southwesterly and southerly during the spring and summer but northerly and northeasterly during the fall and winter.* At Myrtle Beach Airport, located in North Myrtle Beach, winds are generally light and variable with prevailing winds coming out of the Northeast and Southwest. At Myrtle Beach Air Force Base, winds tend to be light and variable also, but direction favors the North-northwest and South-southeast.

The mean annual temperature of the Waccamaw Region is 64.8°F with an average of forty-five days when the temperature is less than 32°F and 80 days when the temperature is greater than 90°F. An average frost-free growing season is 245 days from mid-March to mid-November.

Summer air temperatures usually range from 70° to 90°F. Ocean water temperatures vary from about 79°F in June to 80°F in July and August. Winter air temperatures vary from the mid-thirties in the morning to the high fifties in the afternoon. Water temperature of the ocean in winter drops to 50°F.

The transition periods of spring and fall are fairly short. Rapid warming of the land occurs in the spring, and fall is characterized by warm days and cool nights.

The mean annual precipitation is 49.25 inches, with nearly half that amount falling from June to September. The frontal and cyclonic activity during winter and summer make them the wettest seasons. This activity causes most rain to fall in brief showers and allows for a 60 to 70 percent possibility of sunshine daily.

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* Black, Crow and Eidsness, Inc., "Master Plan of Wastewater Facilities (201 Facilities Plan) for the Grand Strand Region," Revised November, 1974.

Severe weather conditions for the coastal area can be classified as tropical cyclones, hurricanes, and great hurricanes. Probability of annual occurrence of one of each of these storms is shown below.

Probability of Occurrence

Storm Type	Area 35 Buford-Myrtle Beach South Carolina	Area 36 Myrtle Beach-Wilmington North Carolina
Tropical Cyclone	0.05	0.16
Hurricane	0.02	0.17
Great Hurricane (winds 125mph)	0.01	0.01

Major hurricane damage occurred on the coast in 1822, 1906, and 1954. Generally, storms cause only minor damage. Recent observations of unusual weather conditions include:*

- Water spout, July 23 or 24, 1975; no damage observed
- Tornado, May 15, 1975 about 4 miles Northwest of Myrtle Beach Air Force Base; impact not known.

2.5.2 Existing Air Quality

The permanent and seasonal residents of the planning area enjoy high quality air for several reasons:

- Weather conditions provide adequate dispersal of pollutants
- Few stationary sources of air pollution exist in the planning area and neighboring areas such as Georgetown and Conway
- There is no widespread traffic congestion.

The major contributors to air pollution in the area are automobiles and gasoline-engine boats. Aviation operations at Myrtle Beach Air Force Base, Myrtle Beach Airport and other smaller airports, together with stationary sources at Conway and Georgetown, are the other significant contributors to air pollution.

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* Weather station, Myrtle Beach Air Force Base.

Air quality data for Conway and Georgetown has been measured daily since 1972 by the South Carolina Department of Health and Environmental Control (DHEC) and sampling stations located immediately at the boundaries of the planning area. Summaries of the data are compared to standards for the corresponding air quality parameters for 1972, 1973, and 1974 in Table 2-10. Interpretation of these data yields the following conclusions:

- Concentrations of particulates in the Georgetown area have violated the standards for the past two years, while concentrations of particulates in Conway are well within standards
- Sulfur dioxide concentrations for both Conway and Georgetown have been about ten times less than the standards
- Gasoline-engine-related pollutants, nitrogen dioxide and total oxidants, have been well within the standard.

These results imply that:

- Dispersion of particulates are in the southern portion of the planning area leads to concentrations of particulates in the area which are within standards
- In the remainder of the planning area, particulates are further dispersed so that the vast majority of the sections have particulate concentrations which are well within the limits of the standards
- The area has very low concentrations of sulfur dioxide
- Gasoline-engine-related pollutants are well within the standards.

Table 2-10
Air Quality Data for Conway, South Carolina

Air Quality Parameter	Annual Measure	Standard, Microgram/ Cubic Meter	Year 1972	1973	1974
Suspended Particulates mg/m^3	Geometric Mean	60		42	36
Sulfur Dioxide, mg/m^3	Arithmetic Average	80		5	8
Nitrogen Dioxide, mg/m^3	Arithmetic Average	100		32	17
Total Oxidants mg/m^3	Arithmetic Average	100		20	16

Air Quality Data for Georgetown, South Carolina

Air Quality Parameter	Annual Measure	Standard, Microgram/ Cubic Meter	Year 1972	1973	1974
Suspended Particulates mg/m^3	Geometric Mean	60		76	72
Sulfur Dioxide, mg/m^3	Arithmetic Average	80		6	9
Nitrogen Dioxide, mg/m^3	Arithmetic Average	100		40	17
Total Oxidants mg/m^3	Arithmetic Average	100		10	15

Areas identified by the DHEC as problem areas for air pollution include Charleston (AQCR 199), Columbia (AQCR 200), Augusta-Aiken (AQCR 053), and Greenville-Spartanburg (AQCR 202).

Data coming from DHEC week of August 26 concerning AQCR 204 Georgetown include:

- Existing emissions of stationary sources,
- Requirements for restricting future emissions,
- Comparison of impacts to those of other AQCR's.

2.5.3 Noise

The leading generators of noise in the planning area are aircraft takeoffs and landings from the combined Myrtle Beach Air Force Base and civilian airport and the Myrtle Beach Airport.

The North-South orientation of flight paths at Myrtle Beach Air Force Base makes the ocean a large part of the noise impact zone. The City of Myrtle Beach lies just outside the major impact zones. The areas most significantly affected by noise are the beaches just south of the city, the air base itself, and the suburban and rural areas just north of the Intracoastal Waterway in the vicinity of Route 501.

Most of the noise impact from operations at Myrtle Beach Airport is contained in the immediate vicinity of the landing strips.

Other major sources of noise include:

- Vehicular traffic
- Wave action of the ocean
- Insects in forested areas.

On the whole, noise in the planning area is concentrated in the vicinity of the existing Air Force Base and is not a significant problem.

2.5.4 Odor

The planning area is relatively free of odor problems. Some residents of the Myrtle Beach area, however, have detected an odor probably generated at the paper mill in Georgetown.

Other odors from human activities include those from sewage treatment operations, specifically:

- Oxidation ponds
- Primary treatment plants
- Septic systems
- Cesspools.

Natural odors are more prevalent in the rural areas. Typical causes are swamp gas and decaying organic matter in wetlands.

2.6 SENSITIVE NATURAL AREAS

The Grand Strand area includes many examples of various coastal ecological types. Sand dunes parallel the 50-mile beach, the flatter inland areas support pine-oak flatwoods with scattered swamps of cypress-gum association. Along the Waccamaw River are wooded swamps with marshes becoming increasingly prevalent toward Winyah Bay. The upper marshes are fresh, with salinity increasing toward the bay. These lower, brackish marshes grade into salt-marsh in the Winyah Bay - North Inlet area.

Much of the Waccamaw fresh marsh area was used in rice agriculture during the colonial period. Although rice is no longer farmed, the drainage system and dikes in many of the areas are maintained to provide a waterfowl habitat. Though hunted, in season, these marshes also provide prime fresh marsh environments.

2.6.1 North Island Inlet

Special note should be taken of the North Inlet area adjacent to North Island and the nearby mainland. Studies indicate that this estuary salt marsh system is one of the least degraded on the east coast. This highly sensitive environment is of great importance as a spawning-nursery-maturing ground for invertebrates such as white and brown shrimp, blue crab, oysters and clams, and also many species of fish. Associated with these obviously valuable species is an array of lesser known plankton forms, smaller crustaceans, mollusks, and forage fish. These plant and animal forms utlize the rich nutrient base in the diverse tidal creek - marsh habitats. The result is one of the most active, highly productive environment types known.

The projected plans for wastewater control in the Grand Strand area pose a threat to the stability and pristine quality of the inlet and nearby salt marsh. According to Mr. Stuart Ballard, Director of Baruch Institute Marine Field Laboratory, there is a present recurring coliform problem in North Inlet waters. Generally, this problem appears under certain combined weather-tide conditions. West winds crossing Winyah Bay at high tide apparently divert polluted Waccamaw River water into Mud Bay, through the channels, and into the inlet estuary.

Attention should be given to this and related problems concerning level of treatment, actual dilution by river water, and disinfection at plants G and C in the regional wastewater plan. Concern for water quality contributions, from other sources tributary to Winyah Bay, should be extended to the nearby region.

2.6.2 *Inventoried Natural Areas*

The following are sensitive natural areas located in the Grand Strand Area:

- *Mud Bay Islands (Pumpkinseed Island)*. This small island supports marsh elements of *Spartina* spp., *Juncus roemerianus* and *Iva frutescens*. It is occupied by a wading bird rookery. Species breeding include: glossy ibis, white ibis, Louisiana heron, great egret, snowy egret, cattle egret, little blue heron, black-crowned night heron, green heron, least bittern. An interesting occurrence here is an overlap of king rail (fresh marsh) and clapper rail (salt marsh) species. Egrets nest in the marsh elder shrub. Ibis exist in the *Juncus* zone. Wood ibis and the above species roost on the island after the breeding season.

- *North Island*. This island is characterized by open dunes, dune and beach grasses, and scrub forest (also some pine-oak-magnolia). Representative species are: Dune - sea oat (*Uniola paniculata*), cordgrass (*Spartina* spp.), dropseed (*Sporobolus virginica*), railroad vine (*Ipomea pes-caprae*), spurge nettle (*Bivonea stimulosa*). Coastal scrub-wax myrtle (*Myrica cerifera*), dwarf live oak

(*Quercus virginiana* var. *geminata*), greenbriar (*Smilax auriculata*), sparkleberry (*Vaccinium arboreum*), staggerbush (*Lyonia ferruginea*). *Coastal Strip (Maritime) Forest Elements* - loblolly pine (*Pinus taeda*), red cedar (*Juniperus virginiana*), water oak (*Quercus nigra*), sweet bay (*Magnolia virginiana*), red bay (*Persea borbonia*). Breeding colonies of terns and shorebirds are located on North Island. Species of the plover-sandpiper group, plus willet, royal tern and black skimmer make up the breeding population. Migration and wintering populations are more diverse.

- *North Inlet Estuary*. This is an undamaged estuary, adjacent salt marsh and tidal creeks and channels. It is under the control and study of Belle W. Baruch Research Institute. Extensive studies of the estuary have been, and continue to be, carried out by the nearby Institute. The waters are rich in species and productivity.

- *Debidue Island*. This dune area is held by a vegetation association dominated by sea oat (*Uniola*). To the north is a pine-oak association. The dominant species present are: loblolly pine, long-leaf pine (*Pinus palustris*), shortleaf pine (*Pinus echinata*), live oak (*Quercus virginiana*), turkey oak (*Q. laevis*), water oak (*Q. nigra*) and blackjack oak (*Q. marilandica*).

- *Hobcaw Forest*. In its several sections the Baruch Research Institute study area includes about 70,000 acres. A large part of this is in coastal flatwoods. Most of the forest area is second growth, though some of it is near virgin, and understory and herbaceous species are representative of original vegetation associations. Pine flatwoods include the tree species listed above. The pine species predominate on the former croplands. *Cypress-gum swamp forest* - Species are: baldcypress (*Taxodium distichum*) and tupelogum (*Nyssa aquatica*) on wetter sites. Drier sites - water oak, laurel oak (*Q. laurifolia*), sweetgum (*Liquidambar styraciflua*), sweet bay, red bay, red maple

(*Acer rubrum*). Understory species are: holly (*Ilex* spp.), swamp palmetto (*Sabal minor*), sweet pepperbush (*Clethra alnifolia*), spanish moss (*Tillandsia usneoides*) is a common epiphyte. The redcockaded woodpecker, an endangered species, is common and breeds in large, old pines.

- *Huntington State Park*. This park is known for its dunes, fresh water ponds, and wildlife. Dune vegetation is much the same as the sites described above. The ponds hold various submersed and emergent vegetation of value as food and cover for wildlife species. Several species of ducks winter here as well as in the Waccamaw River marshes. Observation opportunities are good.

- *Buist Game Management Area*. This large area is managed for timber production and is open for white-tailed deer hunting under special season and rule arrangements.

- *Waiter Island*. This island is located adjacent to the North Carolina state line. Dunes extend for about 3 miles. Dune vegetation is a special feature of the area. *Panicum anafulum* is notable.

2.6.3 Carolina Bays

These oval depressions are scattered on the coastal plain from Georgia to Maryland. They are especially common in the Grand Strand area. The eastern edge or curve is usually raised in a sandy ridge or low dune structure while the center expanse is generally level and may be dry or wet, even a pond. The vegetation of the inner area is usually evergreen thicket (*Ilex vaccinium*) and pond pine is often the dominant tree species. The sand ridge edging the "bay" is the most common habitat for venus flytrap. At present, none of these Carolina Bays appears to lie within reserved lands.

2.6.4 Endangered Species

Endangered species include:

- Red-cockaded Woodpecker. This bird is locally common, requiring old pines, with "red-heart" disease for nesting sites.
- Brown Pelican. This bird is found along the coast. The only nearby breeding colony is located at Cape Romain.
- Bald Eagle. There are probably no nest sites in Grand Strand area for this bird. Nests (3-5) are nearby south and west of Winyah Bay. Bay and estuary areas are important food source areas for this species.
- Kirtland's and Bachman's Warblers. These are not breeding in the area but could occur as rare migrants. They can be found in scrub, pine-oak forest, or swamp forest.

CHAPTER 3

MANMADE ENVIRONMENT

3.1 CURRENT AND PROJECTED POPULATION

Discussion of the current and projected population of the sewer service area is complex because of the seasonal population variation and the tourist based economy. The population to be serviced actually consists of two distinct micro-populations—the permanent population and the tourist population. Analysis of the planning area population is complex for two reasons. First, it is centered on the Grand Strand and is typified by areas of dense development and rapidly expanding population. In contrast, the remainder of the two-county area derives its economic support from rural agricultural activities and is typified by slow growth. As a consequence, general county data is not very useful in describing activity on the Grand Strand.

Secondly, it varies in size seasonally. The Grand Strand fifty mile strip of beach and its unique system of over 30 championship golf courses are major tourist attractions. Although recent emphasis on promoting reduced rate off-season golf packages has increased spring and fall tourist activity, most tourism still occurs in the summer months. The estimated permanent or winter population of approximately 40,000 people expands during the summer to a city the size of Charleston and its suburbs (approximately 212,000 people during 1972's peak day). Although census statistics are available to describe the permanent population, estimates of the summer or tourist population are difficult to develop.

The traditional use of the ten year census statistics is further complicated by the pattern of growth which has occurred in the Grand Strand area over the past 10 years. The opening of Myrtle Beach Air Force Base in November 1956 stimulated growth during the late 1950's and early 1960's. The Grand Strand area was traditionally a summer vacation area for North and South Carolinians. During the sixties, the area began to expand its appeal into the traditional Flordia markets of the Northeast and Midwest. The major growth in tourism development occurred after 1965. As a consequence, averaging population growth between the 1960 and 1970 census counts would result in an artificially depressed trend line rate of growth.

The remainder of this discussion describes the growth of the micro-populations in the planning area and provides an understanding of the economic activity underlying the potential for expansion of the Grand Strand's population.

3.1.1 Area Population Trends

The sewer planning area, encompassing the area commonly referred to as the Grand Strand, consists of four of the County Census Divisions (CCD) located within Horry and Georgetown Counties (See Table 3-1). One of the four CCDs, Waccamaw, is located in Georgetown County; and the remaining three, Little River, Conway East, and Myrtle Beach are in Horry County. In 1970, the four CCDs had a permanent population of 32,743 people which represented a 20.4 percent increase over the 1960 population level.

Neither Georgetown nor Horry County had a county-wide growth rate during the 1960-1970 period comparable to that of the planning area. Georgetown County contained 33,500 permanent residents in 1970, 3.7 percent less than 1960. Only three of its seven CCDs grew, one of which, Waccamaw, is part of the planning area. All three are neither near or adjacent to the Atlantic Ocean.

Horry County's 1970 population was 69,992, a 2.6 percent increase over 1960. Only four of these fourteen CCDs gained in population during the ten year census period. Three of these four divisions are included in the planning area.

Since 1974, the two counties have experienced greater growth. The South Carolina Division of Research and Statistical Services has developed county population estimates for 1974. These estimates indicate that Georgetown County reversed its trend of population decline established during the 1960s and grew by 9.9 percent from 1970 to 1974.

The updated population information* for Horry County indicates that the County population reached a level of 83,700 people in 1974, a 19.5 percent increase since 1970. The State of South Carolina attributes the population increases for both Counties to the expansion of the tourist and manufacturing sections of the economy and the resulting increase in employment opportunities.

The State did not prepare population estimates for statistical areas smaller than the county for 1970-1974 period. The Waccamaw Regional Planning Commission prepared a 1972 estimate of the permanent population on the Grand Strand by surveying occupied housing units and applying an estimate of residents per unit. This technique yielded an estimate of 40,700 permanent residents in the sewer planning area, a 20 percent increase over the 1970 census

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* State of South Carolina, Budget & Control Board, Division of Research and Statistical Services

Table 3-1
Populations of Sewer Service Area
1960 - 1970

County	Division	1960	1970	Percent Change
Horry	Little River	3,809	4,960	30.2
	Atlantic Beach Town	--	215	
	N. Myrtle Beach Town	--	1,957	
	Conway East	3,122	3,419	9.5
	Myrtle Beach	17,619	21,211	2.4
	Myrtle Beach City	7,834	8,536	9.0
	Myrtle Beach AFB	--	3,864	--
	Surfside Beach Town	--	1,329	--
Georgetown	Waccamaw	2,614	3,153	20.6
Total (Divisions)		27,164	32,743	20.5

Note: Minor adjustments were made in the Horry County CCD's since 1960. Parts of Conway North, Conway South and Conway West Divisions annexed by Conway Town, coextensive with Conway division. Atlantic Beach town incorporated from part of Little River division. Cherry Grove Beach, Crescent Beach, and Ocean Drive Beach towns consolidated as North Myrtle Beach town. Surfside Beach town incorporated from part of Myrtle Beach division. Myrtle Beach town changed to city since 1960. Part of Myrtle Beach division annexed by Myrtle Beach city.

Source: U.S. Bureau of the Census.

estimates. Thus, population growth in the early seventies for the two-county region continues to be concentrated in the Grand Strand area and is based on expansion of a tourist economy. The inland areas of the two counties continue to experience strong out-migration as the rural, agriculturally oriented population leaves to seek other employment opportunities.

3.1.2 Demographic Characteristics of the Region

Table 3-2 displays the age distribution for the population of the planning area and Georgetown and Horry Counties. The age distribution of the planning area's population in 1970 was very similar to the age distribution of the two Counties of which it was a part. Median age in the planning area CCDs was between 23.6 and 27.6. The percentage of the population which was over 65 was between 7 and 10 percent in the planning area and the counties in general. No one area was apparently favored as a place to retire or to raise children. The study areas seem to be fairly homogeneous in population distribution.

Horry and Georgetown Counties are below the national levels for personal income in non-SMSAs as indicated in Table 3-3. They were also below the average for the State of South Carolina. However, the rate of change between 1969 and 1973 shows a growth rate for personal income greater than either the national or state averages. This seems to indicate an improving economy for Horry and Georgetown Counties during the period.

3.1.3 Area Tourist Population

The State of South Carolina* estimates that 35 percent of all visitors to the State are attracted to the Grand Strand area. Between 1972 and 1973 out-of-state tourist visits to the Grand Strand increased approximately 15 percent from 2,896,000 to 3,408,700. In 1972, according to local sources, South Carolinian tourists accounted for an additional 7 million visits resulting in a total of 10 million tourist visits.

The 1972 level of visits to the Grand Strand was roughly double the 1965 number of visits. This rapid increase parallels the type of expansion witnessed in southeast coast resort areas during the same period. In Myrtle Beach,

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* State of South Carolina, Department of Parks, Recreation and Tourism.

Table 3-2
Age Distribution: Horry, Georgetown Counties and County Census Divisions (CCDs) Comprising Planning Area

County Division	Percent Under 18	Percent 18 - 65	Percent Over 65	Median
Horry	38	55	7	24.9
Little River	36	54	10	27.6
Conway East	40	53	7	23.6
Myrtle Beach	336	58	6	24.7
Georgetown				
Waccamaw	39	51	10	26.

Source: U. S. Census

Table 3-3
Per Capita Personal Income
1969 & 1973

Place	1969	1973	Percent Change 69 - 73
U. S. (Non-SMSA)	2,904	4,227	31
South Carolina	2,767	3,885	29
Horry County	2,462	3,856	36
Georgetown County	2,130	3,243	34

Note: Preliminary for State of South Carolina

Source: Bureau of Economic Analysis
April 1975 Survey of Current Business

past growth in tourism can be attributed to:

- The general increase in affluence and the related increase in mobility of the American people
- The success of local hotel owners in developing a unique system of golf courses
- The high quality of the Grand Strand's beaches
- The increasing cost and density of development in Miami.

The Waccamaw Regional Planning and Development Council, in a 1972 survey, estimated the total Grand Strand area peak day population. On the basis of the total transient accommodating units available and the number of persons per unit, assuming 100 percent occupancy, the Council estimated the number of overnight visitors. Adding day visitors and permanent population to the estimated number of overnight visitors, the Council estimated a peak day population of 232,800. The Council arrived at this estimate using the following factors.

Type of Accommodation	Persons Per Accommodation	Total Units	Total Visitors
Motel	4	15,893	63,572
Cottage	9	8,082	72,738
Campsite	5	6,987	34,935
Total Overnight Visitors			171,245
Estimated 1972 Permanent Residents			32,807
Total Overnight Population			204,052
Estimated Day Visitors			28,750
Total Peak Day Population			232,802

Previous studies of East Coast resort areas indicate that the WRPDC estimates may be too high, based on the estimate of number of occupants per unit. Although the number of available units resulted from a 1972 survey, there is little basis for substantiating the estimated occupancy per unit. Based upon experience in other resort areas, the average occupancy for motels has been reduced to 2.5 persons and the estimate for cottages to 6 persons. As a result, a more realistic estimate of the total overnight population is reduced by approximately 28 percent to 123,159 persons, and the peak day estimate becomes 184,716 people. However, since this revised estimate was not confirmed by an actual survey, the WRPDC 1972 population figure of 232,000 was used as a baseline for projections.

Accommodations for the transient population were provided roughly on the following basis:

- Cottages — 43 percent
- Motels — 37 percent
- Campgrounds — 20 percent

Although the area's motel inventory has expanded rapidly in the 1967-1972 period (40 percent or 6,367 rooms out of 16,000 were built from 1969-1972), the primary tourist lodging facility is the rented cottage. A third type of facility is the campground. A cursory review of the ownership of these properties reveals that the campground use is a holding use in anticipation of a higher or better use, as conditions warrant.

3.1.4 Population Projections

As discussed earlier, projection of the future Grand Strand area population has many problems. These problems include:

- Historic Data

  Historic data is virtually useless due to the unusual growth of the area's economy during the latter half of the 1960s. From that point on, the tourist sector underwent rapid expansion, causing the recent surge in the area's economy. The expansion of the tourist sector of the economy is continuing, at this point. The growth trends for the area prior to 1967 therefore have little importance in an effort to project what the future population will be. A new trend line has been established.

- Poor Quality of Data:

  Data for the Grand Strand is inadequate for three reasons:

  - The Strand is itself too small an area to receive updated population estimates

- The planning area is a portion of two separate Counties
- The two Counties are themselves part of a County region recognized by the State of South Carolina

To further complicate data collection, the Grand Strand is a loose geographic definition that may have been interpreted differently by different agencies.

- Permanent Versus Transient Population

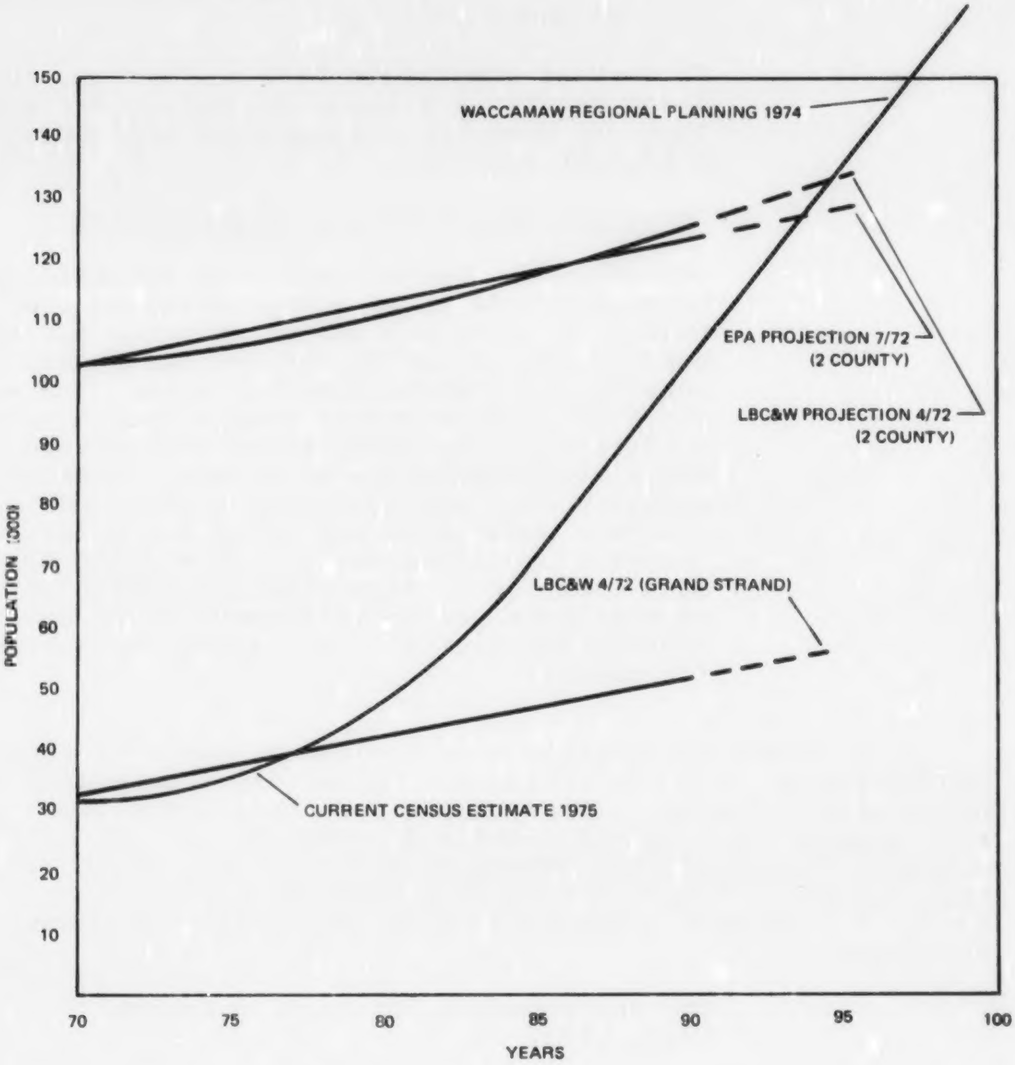
  Generally an area's population estimate can be easily updated by simply totaling the number of housing units constructed and expanding this count by the average number of persons per household in the area. The existence of a large summer population, housed primarily in cottages, makes this method of estimating population difficult. Peak day summer population is also difficult to estimate because on any given day a large number of tourists may not be staying in the area overnight. Also, the conversion of tourist cottages to retirement homes creates further difficulty in preparing population forecasts.

There are sharply conflicting estimates of future population growth. In attempting to analyze future area population patterns, all available pertinent projections of area population were collected and examined. Figure 3-1 compares the population forecasts for the area. Each of these appears to be an original projection arrived at on the basis of different assumptions about the area. They were developed by:

- The Environmental Protection Agency (July 1972)
- The consulting firm of LBC&W (April 1972)
- The Waccamaw Regional Planning and Development Council (1974).

The first two forecasts appear to be based primarily on historical data which does not accurately portray the recent

FIGURE 3-1
Comparison of Projections for
Permanent Population, Georgetown
and Horry Counties, and the Grand Strand



rapid expansion of area tourism. The third forecast appears to place too much emphasis on the recent trends by assuming that recent growth and development will continue indefinitely and will constantly be centered in the Grand Strand area. Although the population curve portrayed by the WRPDC appears to be reasonably accurate for the next 5-8 years, it is expected to flatten later for the following reasons:

- Available ocean front property is a scarcity today and is projected to be fully developed before 1990
- The Grand Strand area is not large and an expansion of the population at an average projected annual rate of 7.9 percent would be reflected in an increased sense of crowding and rapidly escalating real estate prices
- The prices of existing cottages in the beach area are so high that land assemblage for higher density uses will be difficult.

As a result, projections for both permanent and transient population growth were modified. These modifications take into consideration the slow growth years of 1974 and 1975, and the eventual impact of continued population increases in a limited area.

The modified permanent population forecasts are contrasted with WRPDC projections in Table 3-4. The initial five year projection reflects a lower annual rate of growth based on the mortgage problems of 1974 and 1975. The higher annual rate of growth indicated in the next five year period reflects a limited amount of catch up with unsatisfied demand of prior years. The slower longterm rate of growth reflects the impacts of higher prices and area crowding.

Table 3-5 contrasts the WRPDC and modified peak population estimates and Table 3-6 shows the 25 year projection of peak day population by segment. As noted in section 3.1.3, the Council's 1972 peak population estimate appeared to be too high because of an overestimate of occupant per unit rates. However, since actual survey data supporting the estimated lower occupant per unit rate was unavailable, the WRPDC 1972 peak population figure was accepted as a baseline for projections. The modified peak day population projection for 1997 was 498,418, a 1.12 increase annually between 1972 and 1997. The projected sharp decrease in the annual growth rate after 1987 reflects trends observed in other resort areas. Interviews with planning and tourist development officials in Florida and New Jersey have confirmed that popular resorts suffer at some point due to their popularity and consequent

Table 3-4
Contrast of WRPDC Permanent Population Forecasts to a Constrained Forecast

Year	WRPDC Population Growth	Annual Rate	Constrained Projection Growth	Forecast Annual Rate
1972	32,807		32,807	
1977	40,702	4.41%	38,000	2.98%
1982	55,095	6.24%	52,000	6.47%
1987	86,133	9.35%	70,000	6.13%
1992	118,385	6.57%	89,000	4.92%
1997	149,641	4.80	103,175	3.00

Table 3-5
Projected Summer Population

Year	WRPDC Projected Growth	Annual Rate	Constrained Projection Growth	Forecast Annual Rate*
1972	232,802		232,802	
1977	292,748	4.69	290,046	4.49
1982	357,965	4.10	354,870	4.12
1987	443,025	4.36	426,892	3.76
1992	540,385	4.06	471,323	2.00
1997	634,210	3.25	498,818	1.12

* Compounded

Table 3-6
25 Year Projection of Peak Day Population by Segment

Segment	Year					
	1972	1977	1982	1987	1992	1997
Resident	32,807	38,000	52,000	70,000	89,000	103,175
Overnight Transit	171,245	218,733	264,270	312,166	330,498	335,243
Total Overnight	204,052	256,733	316,270	382,166	419,498	438,418
Day Visitors	28,750	33,313	38,600	44,726	51,825	60,000
Peak Day	232,802	290,046	354,870	426,892	471,323	498,418

overcrowding. This is especially true at a beach oriented resort. The ownership of beachfront property by individual hotels has largely reduced the accessibility of bathing areas to people other than hotel guests. Overbuilding in limited space also has reduced the appeal of Miami Beach to tourists who have many vacation resort options within the State of Florida. Officials consider the overcrowding of resorts like Miami to be a primary reason for the growth and popularity of new resort areas elsewhere in Florida, many of which are on the Gulf Coast.

3.2 CURRENT ECONOMIC CONDITIONS

Agriculture was the most important basic economic activity in the study area and in the State of South Carolina prior to World War II. It accounted for a greater inflow of outside money than any other activity. Following the war, the area underwent great change. Agriculture, as a basic activity, became less important as tourism and manufacturing took on greater importance.

Today tourism is the two-county area's most important basic activity. It accounts for approximately 68 percent of all economic activity. Next in importance is manufacturing. Agriculture is third. A fourth basic activity involves the flow of defense spending into the area through the Myrtle Beach Air Force Base. Each of these basic economic activities is discussed below.

3.2.1 Tourism

Tourism is the prevailing economic activity in the coastal areas of Horry and Georgetown Counties. It is the economic heart of the Grand Strand and the 201 planning area. Tourists visit the Grand Strand for two recreational reasons — the ocean and championship golf courses. Swimming and sunbathing are mainly summertime activities. Golf and tennis are fall and spring activities which provide a seasonal balance. Because of this balance, structural development on the Grand Strand has a markedly permanent appearance. Hotels and restaurants have the look of year round establishments in contrast to the development of some northern beach communities.

Facilities serving the tourist population include hotels, restaurants, theaters, golf courses, retail establishments, automotive service areas, marinas, and airports. These establishments also provide employment opportunities for area residents. Available data shows that approximately

9 percent of the 45,056 person work force of the Waccamaw Region (Horry, Georgetown, Williamsburg Counties) in 1970 worked on an annual basis in tourist related activities. Most of these people were engaged in the service and retail sectors. Some were involved in transportation and construction work which directly related to basic tourism. The 9 percent figure was extrapolated from the total retail, service, and construction figures for the region and relates solely to basic tourism. It was provided by the Waccamaw Regional Planning and Development Council.

Tourist spending on the Grand Strand totalled nearly $400 million in 1972. This money flowed from retail and service establishments on the Grand Strand to those who manufacture goods and supply those establishments, thereby providing additional employment. The flow-through of tourist dollars can ultimately generate three to four dollars in trade and payroll in other economic sectors besides basic tourism.

The Chamber of Commerce verified the importance of tourist spending to the Grand Strand economy through random surveys of tourists intercepted on the beach in the summer of 1968 and 1972, was then updated in 1974. In 1968, the average tourist spent approximately $14.98 daily, in contrast to the 1974 tourist whose daily expenditures averaged $22.97 per day. These estimates show that tourist spending increased at a rate of approximately 7.4 percent per year. Expenditures were divided into three categories:

- Food away from home
- Lodging
- Entertainment, travel, etc.

In 1974, food away from home accounted for 25 percent of tourist spending while lodging, and entertainment, travel, etc. accounted for 33 percent and 42 percent, respectively. No effort was made during these surveys to segment tourist expenditures by type of lodging.

Some indicators of volume of tourists visiting the Grand Strand are the number of paid rounds of golf played, paid admissions to the Myrtle Beach convention center, bather attendance at Myrtle and Huntington Beaches, and building permits for Myrtle Beach and the Grand Strand. These are reflected in Figures 3-2—3-6.

FIGURE 3-2
Paid Rounds of Golf
Grand Strand Courses
1962-1975

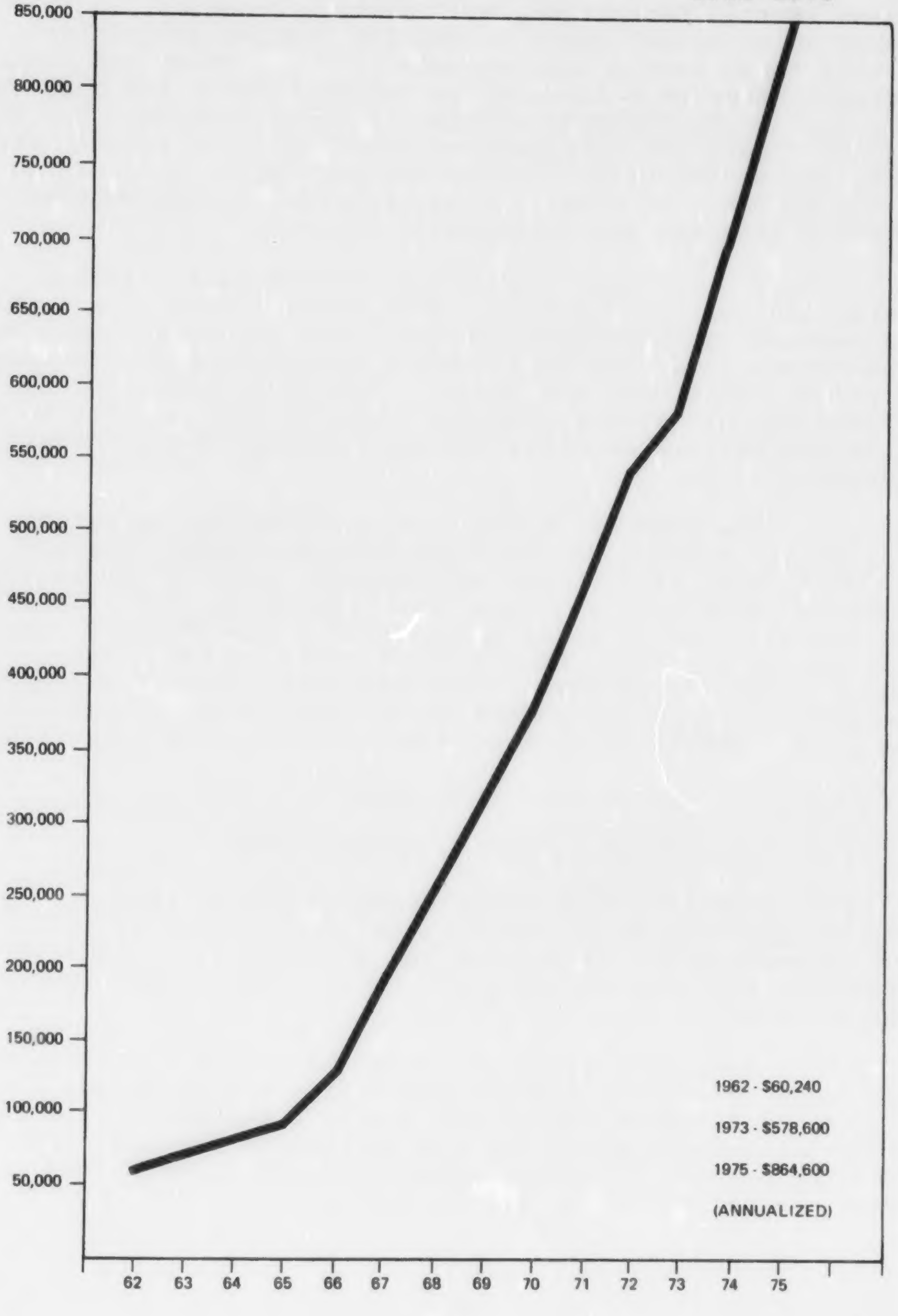


FIGURE 3-3
Myrtle Beach Convention Center
Attendance Figures 1967-1974
(Paid Admissions)

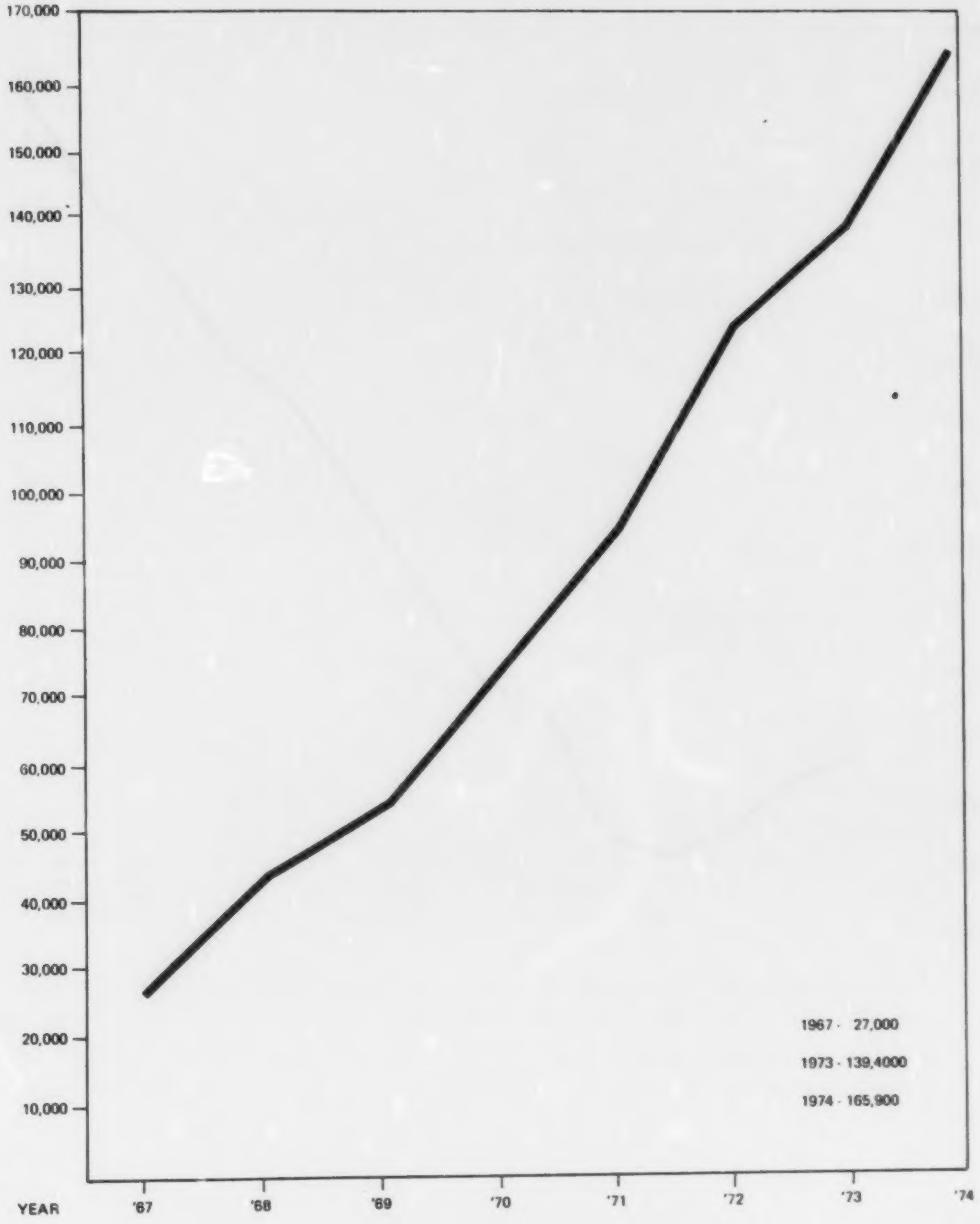
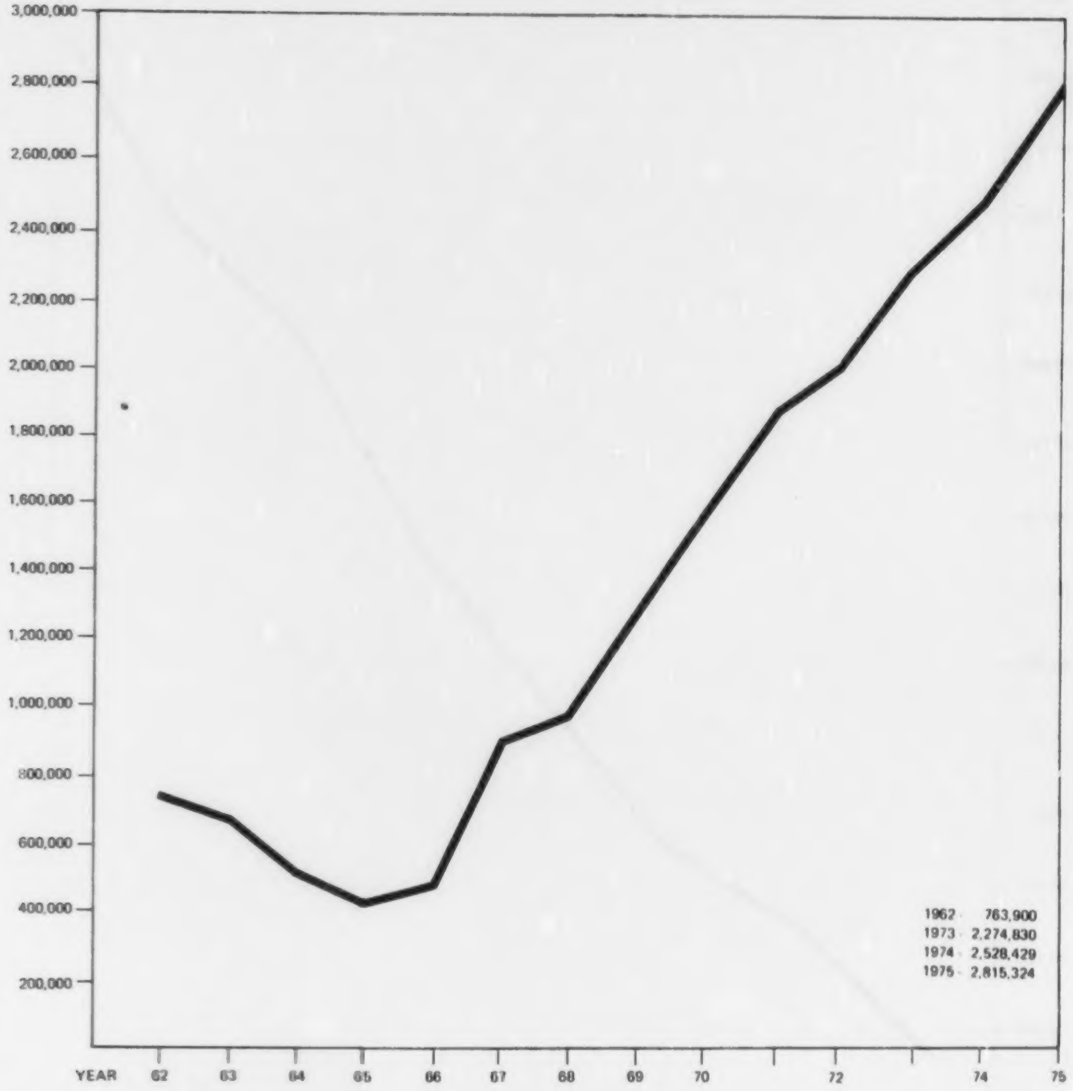


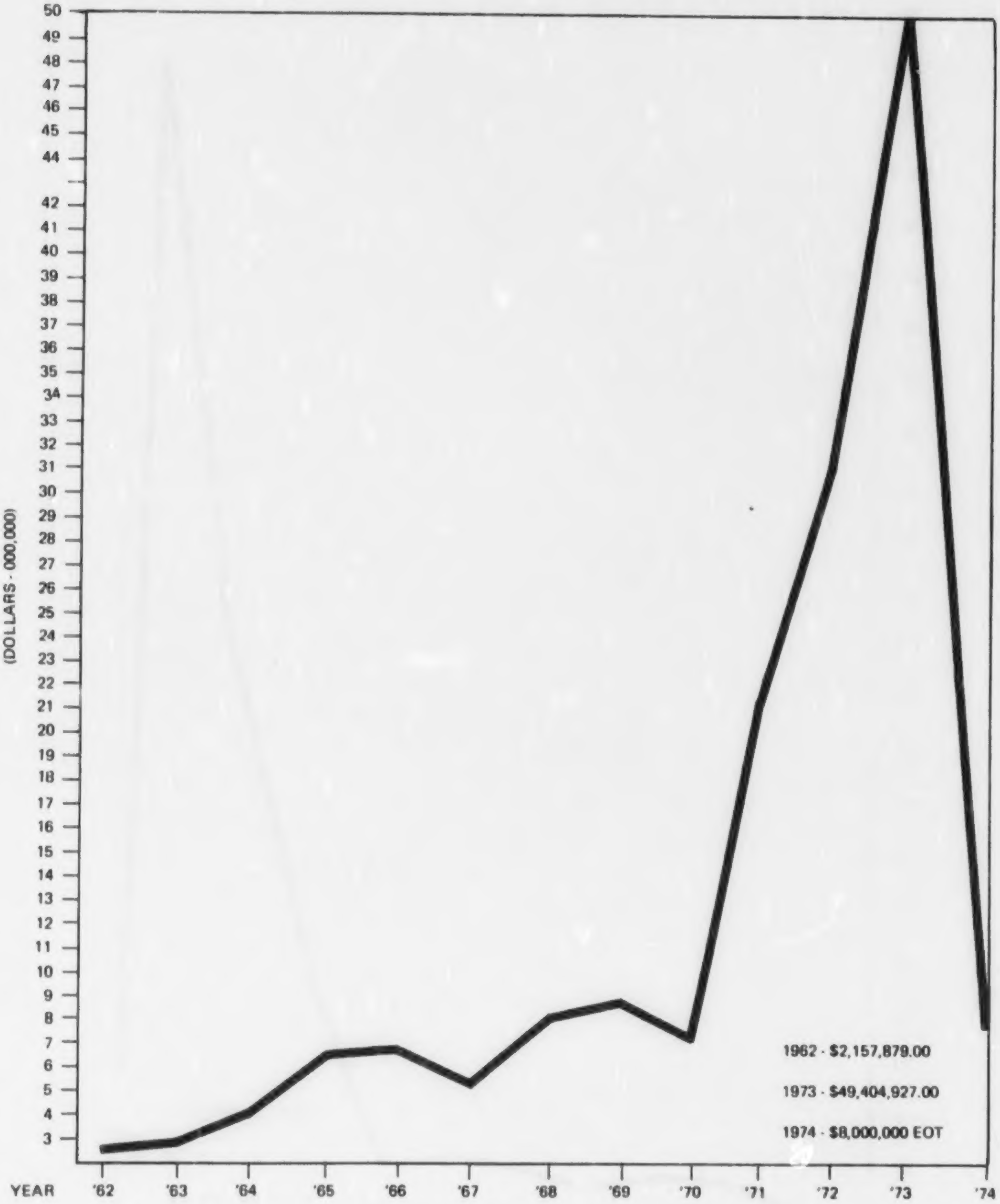
FIGURE 3-4
Attendance
Myrtle Beach and Huntington Beach
1962-1975



SOURCE: S.C. DEPT. OF PARKS, RECREATION & TOURISM

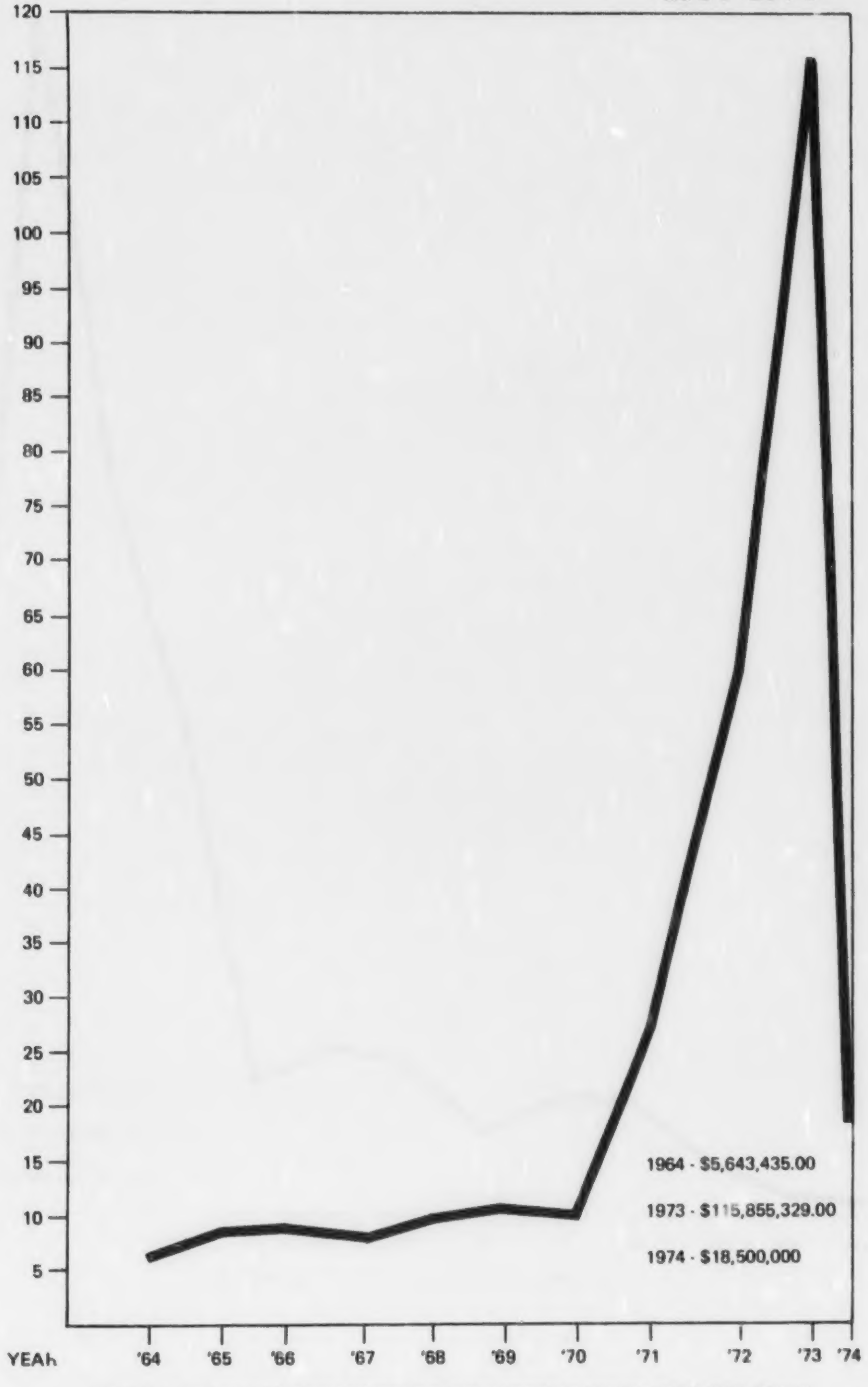
BOOZ, ALLEN & HAMILTON

FIGURE 3-5
Building Permits
City of Myrtle Beach, South Carolina
1962-1974



INFORMATION FROM CITY OF MYRTLE BEACH, S.C.

FIGURE 3-6
Building Permits
Entire Grand Strand
1964-1974



INFORMATION FROM NORTH MYRTLE BEACH, MYRTLE BEACH, SURFSIDE BEACH

The activity indicated by these graphs reflects some important trends in tourism on the Grand Strand:

- The surge in tourist activity began roughly in 1967 and, by 1969, generated a directly related building boom as indicated by Figures 3-5 and 3-6. This surge has tended to limit the value of historic trends as a means of predicting future economic activity.

- Although the recession and the related scarcity in mortgage money drastically reduced building activity to pre-1967 levels, the tourism activity which, in the past supplied the demand for the new construction has continued to be strong. As a consequence, we would expect to see tourist related construction recover as longterm financing becomes available.

- A series of major retirement/second home developments are currently in the planning stages and should begin marketing next season. This would appear to further confirm the opinion that the building boom cycle wll begin again as the economy recovers.

- Existing building plans suggest that initial second home development should occur in the northern sector of the area near the Dunes Club where a number of campgrounds are planned for conversion, and in the Litchfield area where International Paper is currently laying the required infrastructure for an ocean front recreational property.

- Tourism is becoming a diversified business supported by increasing numbers of people on the golf courses, beaches, and attending conventions.

- Significant indicators of tourist activity including attendance at public beaches, paid rounds of golf and attendance at Myrtle Beach Convention Center, have continued to increase dramatically during 1974 and 1975. This increased activity occurred in spite of the gasoline shortage and in the face of the nation's worst recession since World War II.

- Both International Paper at an inland location, and Myrtle Beach Farms at a location with minimal ocean frontage, control significant acreage already planned for golf course oriented residential developments. These large land holdings existing in the hands of financially capable developers indicate that a significant supply of residential property will be brought on the market as demand warrants. Since this property contains little ocean frontage it will probably come on the market at prices permitting retirement development.

Actions currently being taken by area governments and planning agencies should further insure that the area's tourism and retirement draw will continue. These activities include:

- Recent movement of the area's commercial airport activity to the Myrtle Beach Air Force base thereby permitting jet service to the Grand Strand
- Effective sewer planning permitting expansion development as evidenced by the response to the Environs line
- Current efforts to expand zoning requirements and to develop coordinated regional plans.

3.2.2 Manufacturing

Manufacturing is the second most important economic sector. The majority of manufacturing units in Georgetown and Horry County produce milled lumber products. In 1973, 44 percent of the Horry County manufacturing units were involved in the milling of lumber. A larger proportion, 56 percent, milled lumber in Georgetown. Other important manufacturing in the two county areas included food processing, printing, and the production of furniture, textiles, and clothing.

The regional economic importance of manufacturing lies in the salaries it pays to residents of the region. In 1973, the total Georgetown County industrial payroll was $110 million. Of this, manufacturing accounted for

$24 million or 22 percent. These figures show the importance of the manufacturing sector to this two-county area, as well as the greater dependence of Georgetown County on this type of activity.

The best indicator of growth for the manufacturing sector is a comparison of the number of units and employees over a number of years. Table 3-7 shows that the number of units manufacturing in Horry County in 1973 increased 26 percent over 1970. Twenty-two percent more employees were added during this period. In Georgetown County, the unit growth was 22 percent with 5 percent more employees being added. Both counties were above the state growth rate for new units during the period, although Georgetown lagged behind both the state and Horry County, on the number of employees added, as shown in Table 3-8.

Among the new plants in the area which opened within the past two years are the Grove Manufacturing Corporation and the United Merchants and Manufacturing Corporation. Grove produces heavy construction equipment while United Merchants produces yarn. Both are in Horry County.

3.2.3 Agriculture

Agriculture has little economic importance to either the Grand Strand or the 201 planning area. It is, however, still an important economic activity in other areas of Horry and Georgetown Counties. Major products produced include tabacco, eggs, soybeans, and lumber. Sixty-eight percent of the land in the three-county Waccamaw Region is considered commercial forest. Regional timber farming has kept the milling industry prominent among manufacturing activities in Horry and Georgetown Counties.

Although farming retains a strong position within the two-County area's economy, it has generally declined in relation to the other economic sectors. Table 3-9 shows fulltime agricultural employment levels as evidence of the decline.

Table 3-7
Manufacturing Units and Employment
1970-1973

Place	Units			Employment		
	1970	1973	%Change	1970	1973	%Change
South Carolina	3,351	3,579	6	333,610	375,858	11
Horry County	65	88	26	3,632	4,684	22
Georgetown County	69	88	22	4,625	4,864	5

Source: Bureau of the Census, County Business Patterns, 1970
South Carolina Employment Security Commission

Table 3-8
Agricultural Employment as a Percentage of All Employed 1970-1973

Place	Year 1970	1971	1972	1973	Change 1970-1973
South Carolina	17	16	16	16	-1%
Williamsburgh Co.	33	32	33	29	-4%
Georgetown Co.	21	20	20	22	+1%
Horry County	32	30	25	23	-9%

Source: South Carolina Employment Security Commission
Booz, Allen & Hamilton

Table 3-9
Agricultural Employment as a Percentage of
All Employed 1970-1973*

Place	Year				Change 1970-1972
	1970	1971	1972	1973	
South Carolina	17	16	16	16	-1%
Williamsburgh Co.	33	32	33	29	-4%
Georgetown Co.	21	20	20	22	+1%
Horry County	32	30	25	23	-9%

3.2.4 Myrtle Beach Air Force Base

The Air Force Base at Myrtle Beach is important as a sorce of outside money to Horry and Georgetown Counties. The economic effects of salaries and the purchase of local goods and services multiply through the area's economy. In fiscal year 1975, there were 2,822 military personnel stationed at Myrtle Beach. The Air Force employed another 500 civilians.

3.3 PROJECTED ECONOMIC CONDITIONS

During the past decade the economic base of Horry and Georgetown Counties has broadened to include more tourism and manufacturing. The future of these two activities continues to appear bright.

3.3.1 Tourism

The unprecedented growth of the tourist sector during the late 1960's and early 1970's should continue for the Grand Strand and the planning area in the forseeable future. A number of factors will contribute to this continued growth including energy problems and inflation, climate, and the joint use of the Myrtle Beach Air Force Base by military and civilian aircraft. Recent recognition of the area's fine golf courses and an active effort by State and local bodies to promote the area will also effect growth.

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* South Carolina Employment Security Commission Booz, Allen & Hamilton

Climate is an important factor in the future of the tourist sector. Because of South Carolina's mild winters, the area has nearly a year round recreational potential. Although swimming generally has a season from late March to October, activities such as golf and tennis are well suited to cooler days. Golf, as previously shown in the trend line for rounds played, has grown tremendously as a fall and spring activity in recent years. Its peak season is February 15 - April 20, with a secondary peak of September 1 - December 1. It has been suggested that horse racing with parimutuel betting could be established to augment golf and tennis as a cool weather activity and thereby help seasonally balance the number of tourists visiting the Grand Strand.

Reduced energy supplies and the increased cost of fuel, as well as inflation, are generally regarded as problems which would adversely effect tourism. However, because of the Grand Strand's location north of Florida, it is expected that it will become a lower cost alternative to a Florida vacation.

In 1975, Horry County began operating terminal facilities at the Myrtle Beach Air Force Base. Prior to the changeover, small propjets landed at an airport in North Myrtle Beach, which is now used exclusively for general aviation. Since the Air Force Base is able to handle large jets because of the length of its runway, the option now exists for planes with a greater capacity to service the area on a regular or charter basis. This change had long been advocated by the Waccamaw Regional Planning and Development Council and the Horry County Planning and Development Commission as a prerequisite for large scale promotion of the Grand Strand.

A potential constraint in achieving the rapid growth of tourism projected for the Grand Strand area will be the ability of the area's economy to supply the number of transient units required to house the projected overnight tourist population. Table 3-10 provides an estimate of the building space that would be required based on the following assumptions:

- The number of cottages will not expand significantly, primarily because of the increasing scarcity of ocean front property and the general escalation of land prices. The cottage units indicated assume buildout of existing planned resort developments such as DeBordieu and the International

Paper's ocean front site as well as development of interior property owned by International Paper, and interests with some cottage type units.

- The primary form of transient housing is assumed to be the motel unit. The higher density of these units make development possible at the anticipated higher land costs.
- Campsites are presumed to be a holding use for future motel or resort development uses.
- The WRPDC occupancy figures were used to achieve the most conservative estimate of transient accommodations.

Table 3-10
Anticipated Transient Accommodation Requirements for 1997

Type	1972		1997		Net Change		
	# Units	%	# Units	%	# Units	Annual Growth Rate	Average Units Per Year
Motel	15,893	51	46,864	67	30,971	4.4	1239
Cottage	8,082	26	10,082	14	2,000	0.9	80
Campsite	6,987	23	13,410	19	6,423	2.6	257
Total	30,962	100	70,356	100	39,394	3.3	1576

The above analysis indicates motel space will have to increase at an average annual rate of 4.4 percent per year or approximately 1,239 units per year. During the tourism boom years of 1967 to 1972 the Grand Strand area increased its inventory by approximately 1,200 units per year to 16,000 total units. Although the above analysis is very rough, it is adequate to demonstrate the future demands facing both the construction and finance industries in the Grand Strand if the projected growth in tourism is to occur.

3.3.2 Manufacturing

Assuming that the national economy is in a short term recession, growth of manufacturing should continue in Horry and Georgetown Counties at a more moderate pace than the growth of tourism. Consultants for the Waccamaw Regional Planning and Development Council in a 1972 population and economic base study have stated that the more moderate growth rate of manufacturing will be mainly due to the lack of sufficient municipal water and sewer services in other areas of Georgetown and Horry Counties.

3.3.3 Agriculture

The future of the agricultural sector of the Horry - Georgetown area economy depends largely on the growth of the tourist and manufacturing sectors, and the resulting rise in permanent and transient populations. Land values should climb as acreage within the 201 planning area develops. It is expected that farm and forest land in immediate proximity to this development eventually will be taken out of production because of its increased value for development. Therefore, the downward trend for agriculture should continue with the sector remaining dominant in the more rural parts of the two counties.

3.3.4 Myrtle Beach Air Force Base

The Department of the Air Force presently has no plans to reduce or curtail military operations at Myrtle Beach. This situation could change on short notice, however, and would be impossible to predict.

3.3.5 Employment

The latest available data showing a breakdown of employment by industrial type is displayed in Table 3-11. From this we see that Georgetown County is much more typical of the State of South Carolina than is Horry County. Manufacturing accounts for roughly half of all employment, retail trade accounts for roughly one-sixth. Horry County, with its main economic emphasis on tourism, has only one quarter of its labor force employed by manufacturing units with roughly one-half employed by retail and service establishments. If specific data were available for the 201 planning area, it would most likely show a vast majority of its employees involved in the service and retail trade sectors.

Table 3-11
Average Monthly Employment - March 1973

Industry	South Carolina Employees	%	Horry County Employees	%	Georgetown County Employees	%
Manufacturing	375,858	47	4,684	23	4,864	55
Agriculture, Fisheries, Forestry	3,464	1	112	1	—	5
Contract Construction	70,687	9	2,577	12	427	5
Transportation, Communications And Public Utilities	38,097	5	769	4	230	3
Wholesale Trade	36,083	5	600	3	168	2
Retail Trade	136,147	17	5,774	28	1,446	16
Finance, Insurance, Real Estate	34,504	4	924	5	303	3
Services	89,323	11	5,023	24	968	11
Total All Industries	805,927	100	20,644	100	8,782	100

Source: South Carolina Employment Security Commission, September 1974.

3.3.6 Unemployment

Figure 3-7 compares the unemployment rates of South Carolina and Horry and Georgetown Counties from 1970 to 1974. It shows that the Georgetown trend, with a high of 9.1 percent and a low of 7 percent, exceed the unemployment rates of both the State and Horry County.

Figure 3-8 shows unemployment rates on a 1975 monthly basis for both South Carolina and the two Counties. This data illustrates the effect of seasonal employment on the two counties, a factor which does not affect the State of Carolina as a whole.

The unemployment statistics show that a major economic objective for the two-county area is to provide jobs. Therefore, the Waccamaw Regional Planning and Development Council has defined the broadening of its employment base, through tourism and manufacturing, as a primary objective.

3.3.7 Economic Constraints

Two objectives which could benefit the Grand Strand economy are:

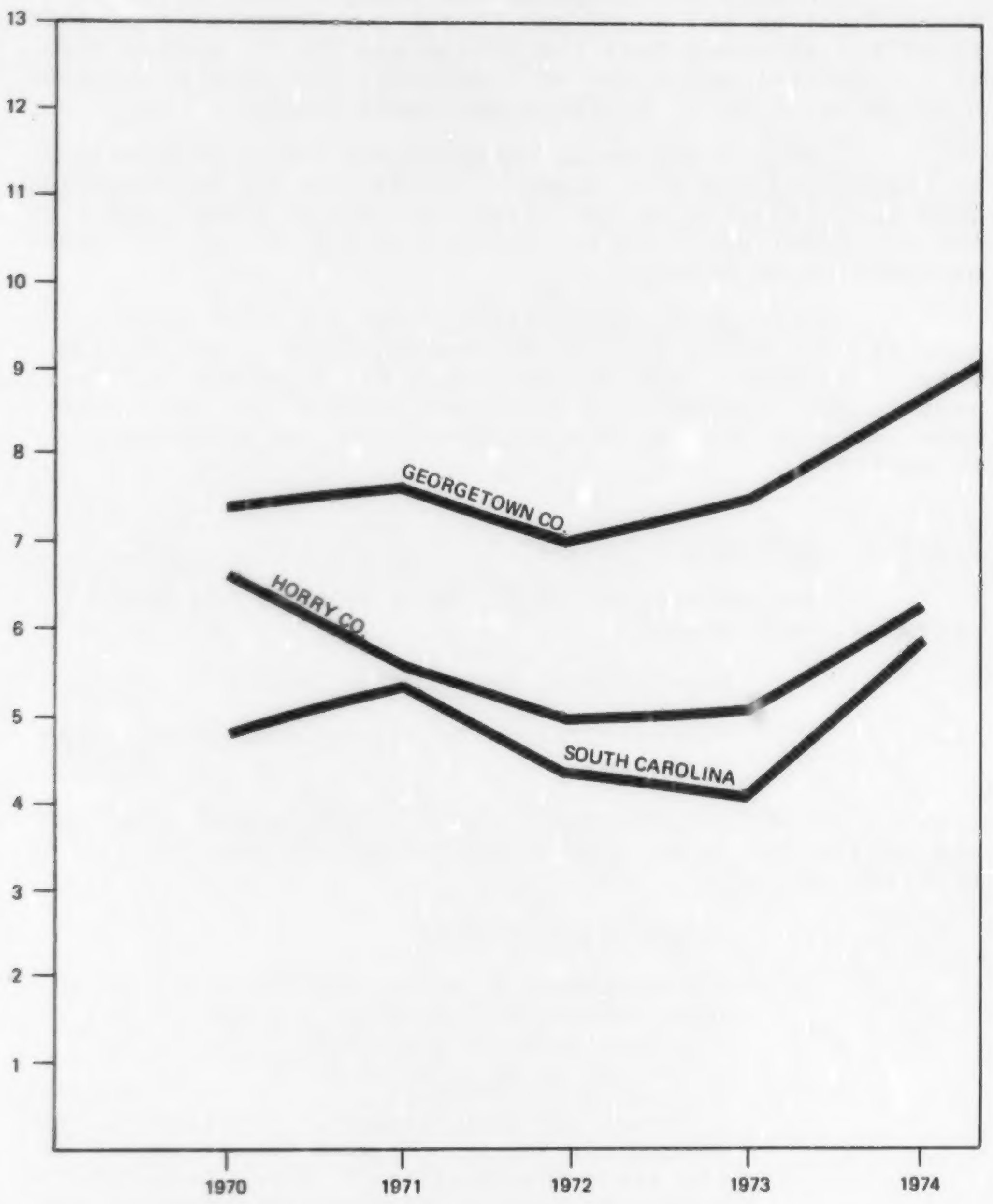
- Extension of the tourist season
- Diversification of its sources of economic activity.

The Grand Strand's short term economic problems are similar to those affecting most of the nation. These problems include:

- Long-term Financing

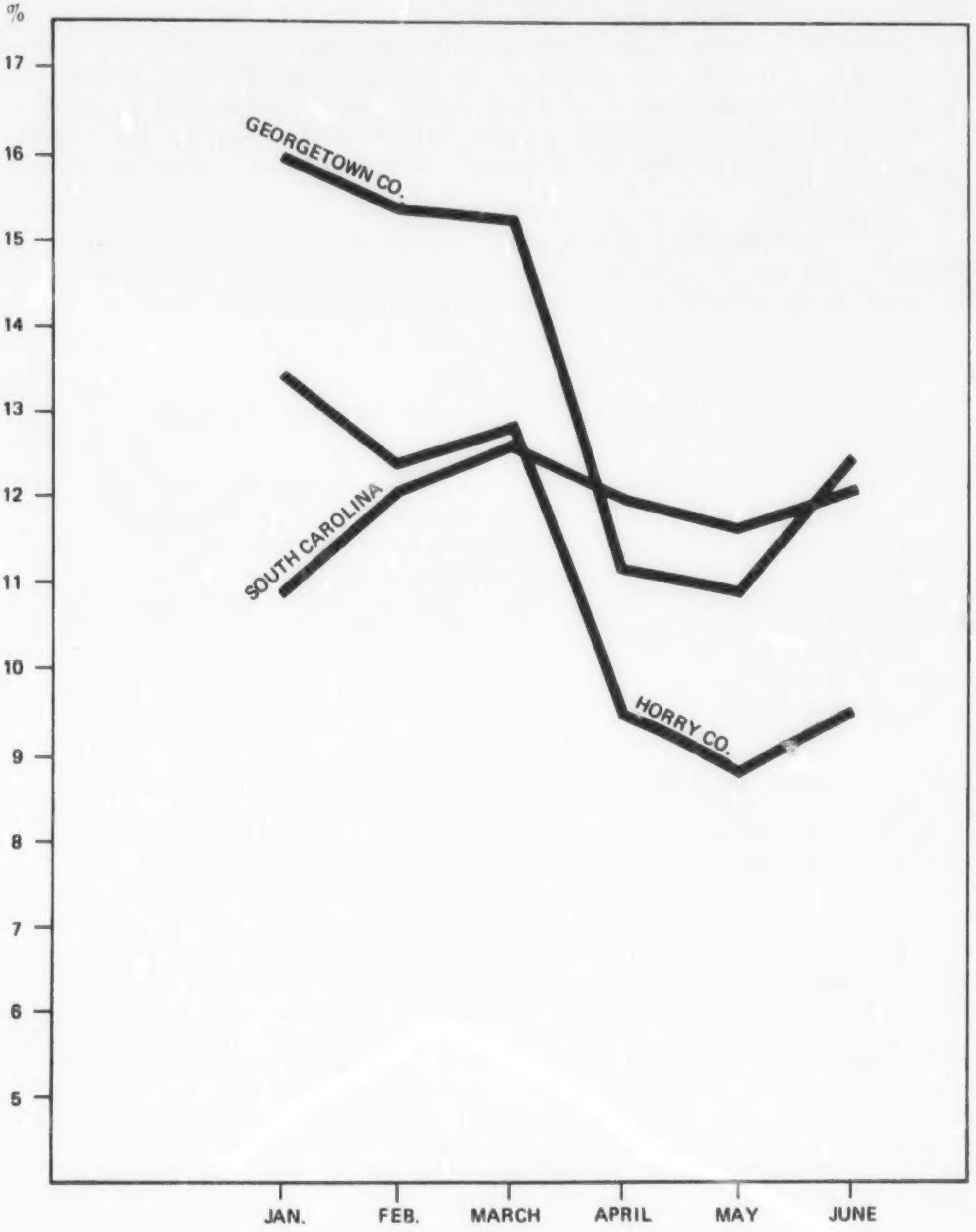
  The shortage of money available for long-term mortgages has severly retarded the building boom in the Grand Strand. Both potential buyers and developers have not been able to obtain financing. Consequently, although national economic problems did not retard the number of tourists attracted to the area, the ability of those tourists to purchase vacation and retirement homes was severely affected.

FIGURE 3-7
Unemployment Rates: 1970-1974
State of South Carolina, Horry County
Georgetown County



SOURCE: SOUTH CAROLINA EMPLOYMENT SECURITY COMMISSION

FIGURE 3-8
Unemployment Rates: January 1975-June 1975
State of South Carolina, Horry County
Georgetown County



SOURCE: SOUTH CAROLINA EMPLOYMENT SECURITY COMMISSION

- The Recession

  The major impact of the current recession on the Grand Strand's economy has been to increase the difficulty of diversifying the local economy. Fewer businesses have been seeking additional plant space and committing themselves to significant capital investments.

Table 3-12 shows the components of the Grand Strand's economic activity in 1972. Clearly, tourism plays the most important role in the area's economy.

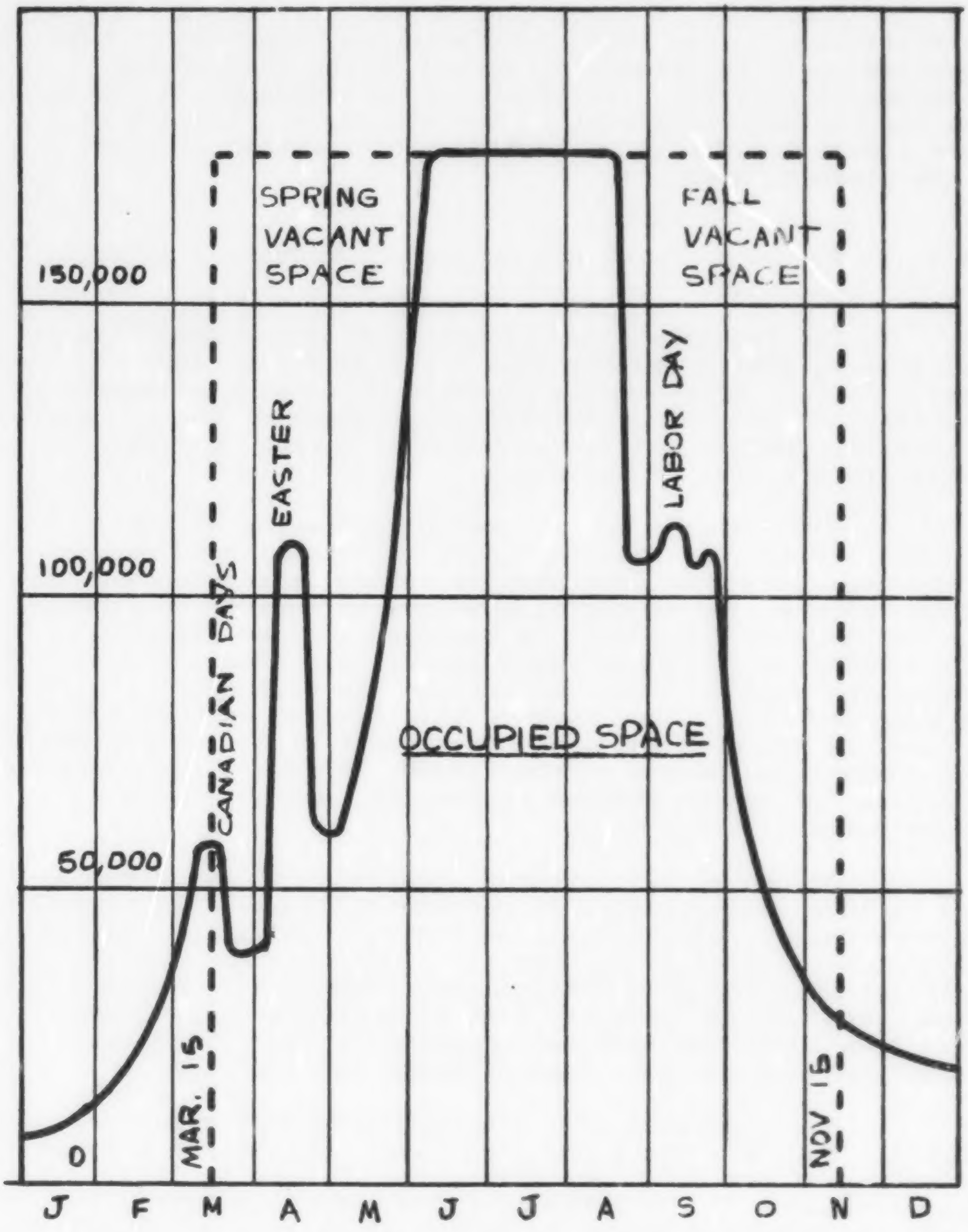
Table 3-12
Major Components of the Grand Strand Economy

Component	Million $	Percent
Tourism	365	68.8
Manufacturing Payroll	60	11.3
Agricultural Sales	56	10.5
Air Base Payroll	31	5.8
Pulpwood Sales	19	3.6

This emphasis on tourism constrains the area's economic development. As Figure 3-9 illustrates, existing tourist capacity is underutilized. Therefore, positions in the tourist industry vary seasonally.

The increased utilization of the area's convention facilities and the successful promotion of an off-season golf package have improved the fall and spring seasons. Additional development of tennis facilities and promotional tennis weeks and packages would also expand the spring and fall seasons. Area planners have attempted to increase winter activity through the staging of special events but to this point have met with only limited success. Expansion of the tourist season, however, will not solve all the area's employment problems. Many of the employment opportunities in tourism are low-income, low-skilled positions. An expanded, seasonally balanced tourist industry will provide a larger portion of long-term jobs but will not improve the low wage and advancement characteristics of the industry.

FIGURE 3-9
1972-Daily Rate of Use
of Grand Strand Overnight Accommodations



Source: Waccamaw Regional Planning and Development Council

Therefore, a major goal of the area is to increase its attraction to desirable manufacturing companies. These companies would be primarily located to the west of the Intracoastal Waterway. It is therefore reasonable to expect that the residences of most of the employees attracted to these plants would also be located either within or close to the planning area.

3.3.8 Relationship of Economic Conditions to Population Forecast

The future economic conditions of the 201 planning area will be able to support the population forecasts of section 3.1.4. This area is expected to grow at a quicker pace than the rest of South Carolina because of the dominance of tourism. Manufacturing is expected to grow at a pace similar to the rest of the state.

Tourism will contribute to population growth in two ways. First, it will introduce retirement-aged persons to the area. Many are expected to return as residents. Second, as the tourist sector expands, an increasing proportion of the work force will be employed in jobs directly or indirectly relating to tourism. It is difficult to project the number of retired persons who will settle in the planning area, since much of this depends on both how the area is promoted and what development plans for retirement communities emerge in the future. However, that portion of population growth induced by tourist related jobs can be projected within a range.

Of the 32,807 permanent residents of the planning area in 1972, an estimated 45 percent or 14,763 constituted the work force. Of these, establishments directly relating to tourism employed 30 percent or 4,500 persons. These establishments included hotels, restaurants, and retail shops. The tourism industry also generated an estimated 5,625 jobs in tourist-related construction and wholesale trade. Many of the jobs were seasonal and part time.

The projected 1997 planning area population is 103,175. In 1997, the work force should constitute a lower percentage of the total population than it did in 1972. Of an estimated 41,270 persons in the 1997 work force, the tourist sector is expected to employ 40 percent or 16,508 persons. The tourist sector will probably generate 18,056 jobs indirectly relating to tourism. Not all of the jobs indirectly relating to tourism will be in the planning area since they will not generally be bound geographically to the Grand Strand. Some of these jobs could be in other areas of Horry and Georgetown Counties, or outside of the State of South Carolina. If all jobs indirectly relating to tourism combined with jobs directly relating were to be in the planning area in 1997, 79 percent of the work force would be involved. This is considered a maximum figure. It is estimated that 65 percent of the planning area work force will be employed in tourist-related activities. Manufacturing can be expected to absorb the remainder of the work force.

The 1997 population will, therefore, consist mainly of retired persons, persons directly and indirectly employed in tourism, persons working in manufacturing, and dependents. The tourist sector will be the dominant employer.

3.4 EXISTING LAND USE

Figure 3-10 shows existing land use in the 201 planning area. Within this area there are three sections with distinct land use characteristics. These sections are:

- The ocean to Route 17 (a major New York-to-Florida highway)
- Route 17 to the Intracoastal Waterway
- The Waterway to the Waccamaw River.

The planning area is bisected by Route 17 down the coast and by Route 501 between Myrtle Beach and Conway.

The coastal section of both Horry and Georgetown Counties has a mix of residential, commercial, and recreational development nearly the full length of the planning area. The most dense commercial development is in the City of Myrtle Beach (Horry County) which is dominated by hotels, restaurants, and amusement areas. Some condominium developments are above Myrtle Beach, along the ocean. Among these projects are Briarcliff Acres, Lake Arrowhead and the Dunes Club. An area of second home cottages runs generally from North Myrtle Beach to Litchfield Beach. Litchfield Beach is the site of a new condominium project, presently under construction. The pattern of various types of both primary and secondary residential development continues down the coast into Georgetown County to the Baruch estate. While the Georgetown County coastal area has types of development

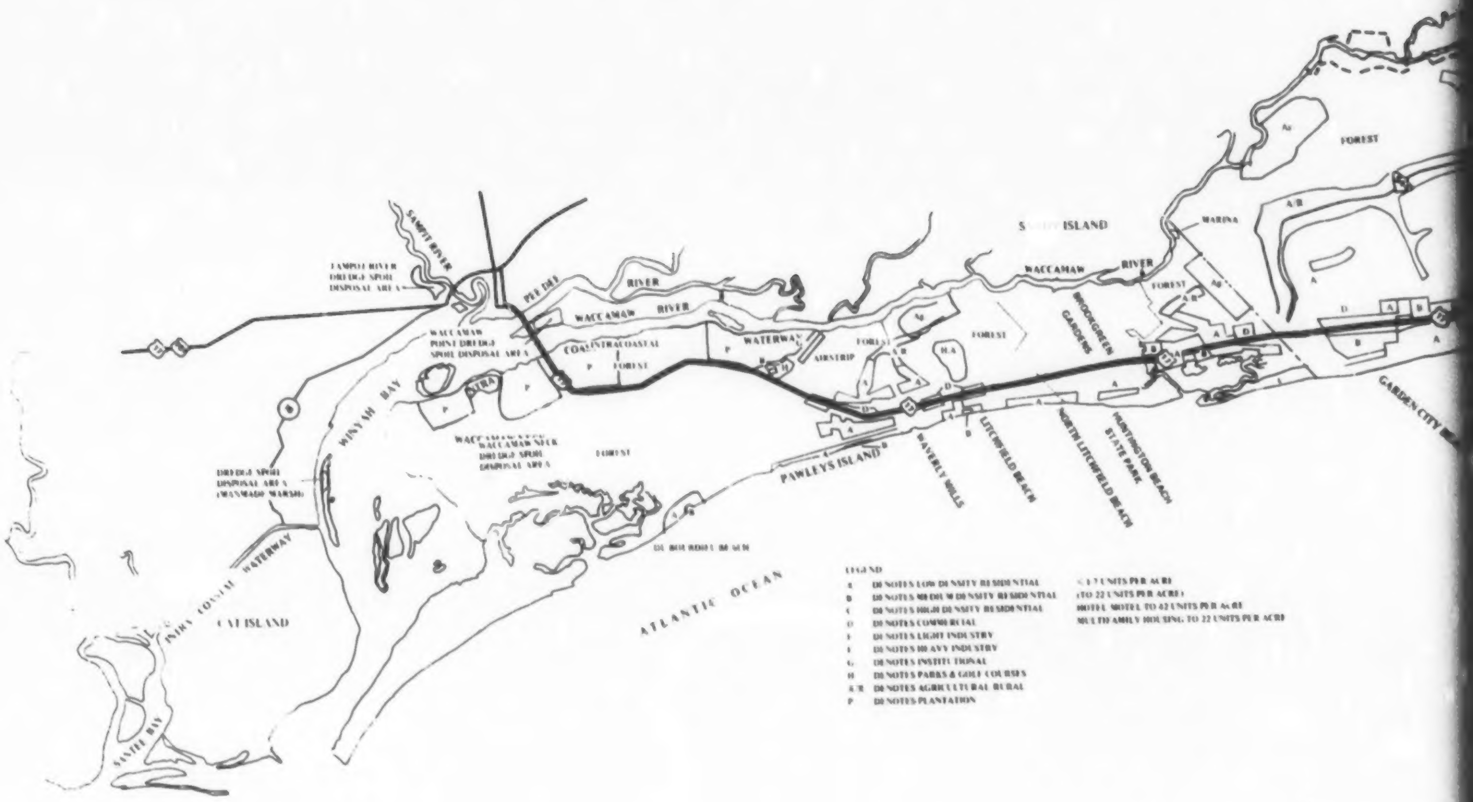
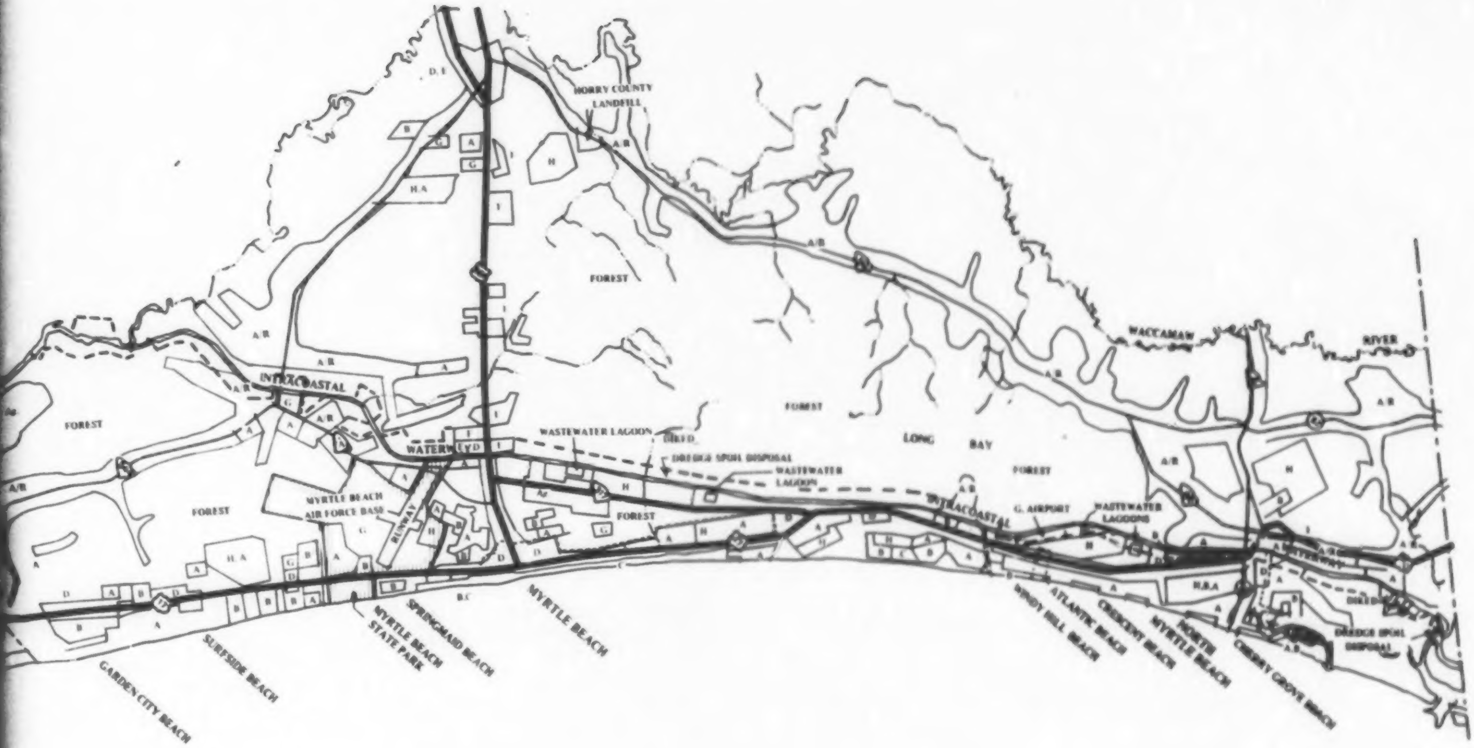

SAMPIT RIVER
SAMPIT RIVER
DREDGE SPOIL
DISPOSAL AREA
PEE DEE
RIVER
WACCAMAW RIVER
WACCAMAW
POINT DREDGE
SPOIL DISPOSAL AREA
COASTINTRACOASTAL
WATERWAY
FOREST
AIRSTRIP
SANDY ISLAND
WACCAMAW RIVER
MARINA
FOREST
A/R
BROOKGREEN
GARDENS
HUNTINGTON BEACH
STATE PARK
GARDEN CITY
WINYAH BAY
WACCAMAW NECK
DREDGE SPOIL
DISPOSAL AREA
DREDGE SPOIL
DISPOSAL AREA
(MANMADE MARSH)
INTRACOASTAL WATERWAY
CAT ISLAND
SANTEE BAY
PAWLEYS ISLAND
WAVERLY MILLS
LITCHFIELD BEACH
NORTH LITCHFIELD BEACH
DE BORDIEU BEACH
ATLANTIC OCEAN
LEGEND
A DENOTES LOW DENSITY RESIDENTIAL
B DENOTES MEDIUM DENSITY RESIDENTIAL
C DENOTES HIGH DENSITY RESIDENTIAL
D DENOTES COMMERCIAL
E DENOTES LIGHT INDUSTRY
F DENOTES HEAVY INDUSTRY
G DENOTES INSTITUTIONAL
H DENOTES PARKS & GOLF COURSES
A/R DENOTES AGRICULTURAL RURAL
P DENOTES PLANTATION
≤ 1.7 UNITS PER ACRE
(TO 22 UNITS PER ACRE)
HOTEL MOTEL TO 42 UNITS PER ACRE
MULTIFAMILY HOUSING TO 22 UNITS PER ACRE

FIGURE 3-10
Existing Land Use Map


HORRY COUNTY LANDFILL
D.I.
FOREST
A/R
H.A
INTRACOASTAL
WATERWAY
WASTEWATER LAGOON
DIKED
DREDGE SPOIL DISPOSAL
WASTEWATER LAGOON
MYRTLE BEACH AIR FORCE BASE
RUNWAY
WACCAMAW
RIVER
LONG BAY
INTRACOASTAL
G. AIRPORT
WASTEWATER LAGOONS
H.B.A
DREDGE SPOIL DISPOSAL
B.C
GARDEN CITY BEACH
SURFSIDE BEACH
MYRTLE BEACH STATE PARK
SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH

similar to those of Horry County, it is somewhat protected from rapid growth and seasonal change by the presence of large open areas. Hotels, restaurants, and a wildlife preserve characterize the Georgetown coastal land uses.

The side of Route 17 opposite the ocean is characterized by much lower density commercial and residential uses. Property values away from the beaches generally are lower, permitting persons with low or fixed incomes, or those desiring a larger lot, to afford the land. The exception to this land use pattern is in the City of Myrtle Beach where dense development and high land costs occur on both sides of Route 17. Outside the city, much of the area between Route 17 and the Intracoastal Waterway remains wooded.

Route 501 from Myrtle Beach to Conway has created a third corridor of development. Beyond the Intracoastal Waterway there are institutional and commercial sites such as Grove Manufacturing, Coastal Carolina College, and the Tech Center. Residential development characterizes the area between Nixon's Crossroads and Little River.

The majority of the land within the 201 planning area which is situated beyond the Intracoastal Waterway is owned by the International Paper Company. This land, the Buist tract, is approximately 42,500 acres and is mostly forest and open space. The company has begun to plan development for the tract.

3.5 PROJECTED LAND USE

Much of the land in the 201 planning area is undeveloped. However, the area is experiencing, and will continue to experience, significant population and economic growth. This growth will produce pressures for land development of various types. Figure 3-11 shows projected land uses.

Few sites are presently available for large scale residential development. Therefore, in the long run such development will most likely occur inland, spreading to and over the Intracoastal Waterway, including portions of the Buist tract. Residential development will also occur on inland tracts in the vicinity of new golf course development as the area becomes more attractive to retired persons. Both high land costs and scarcity of coastal land will require that the new courses be constructed inland.

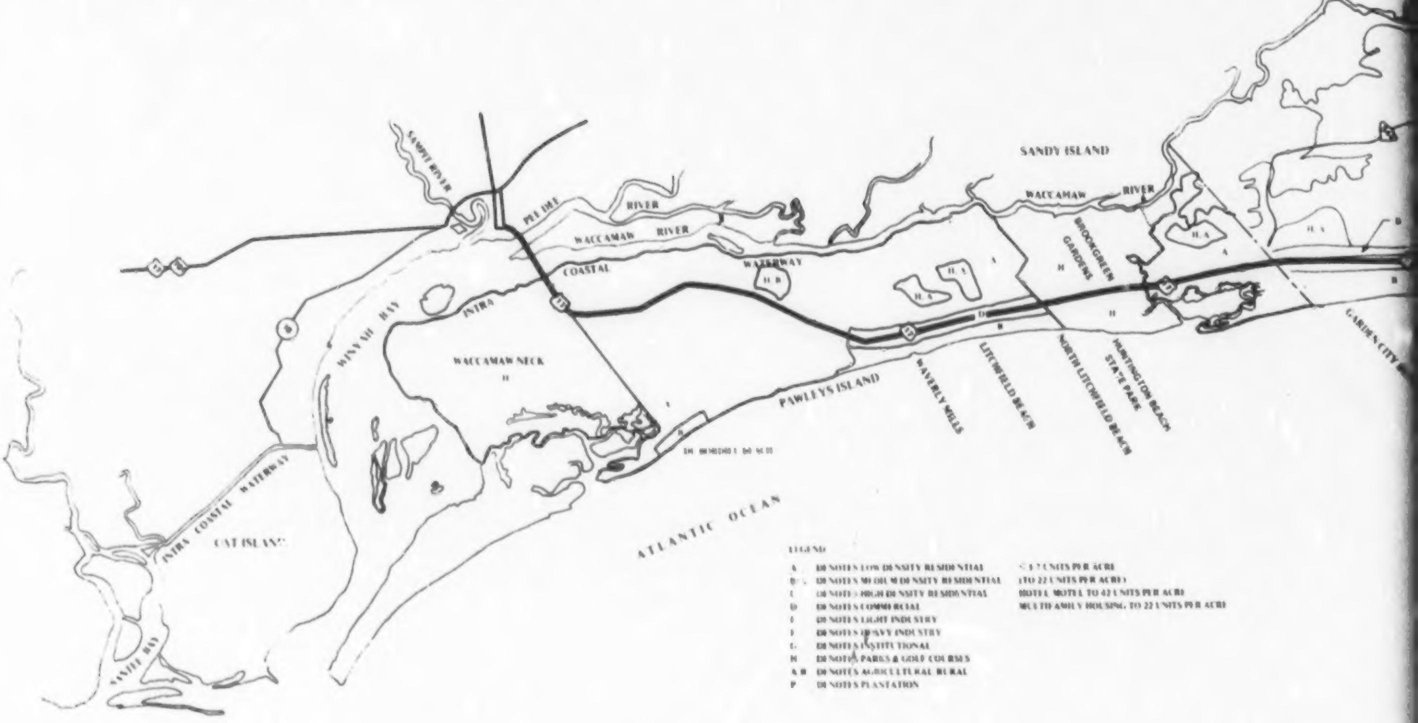
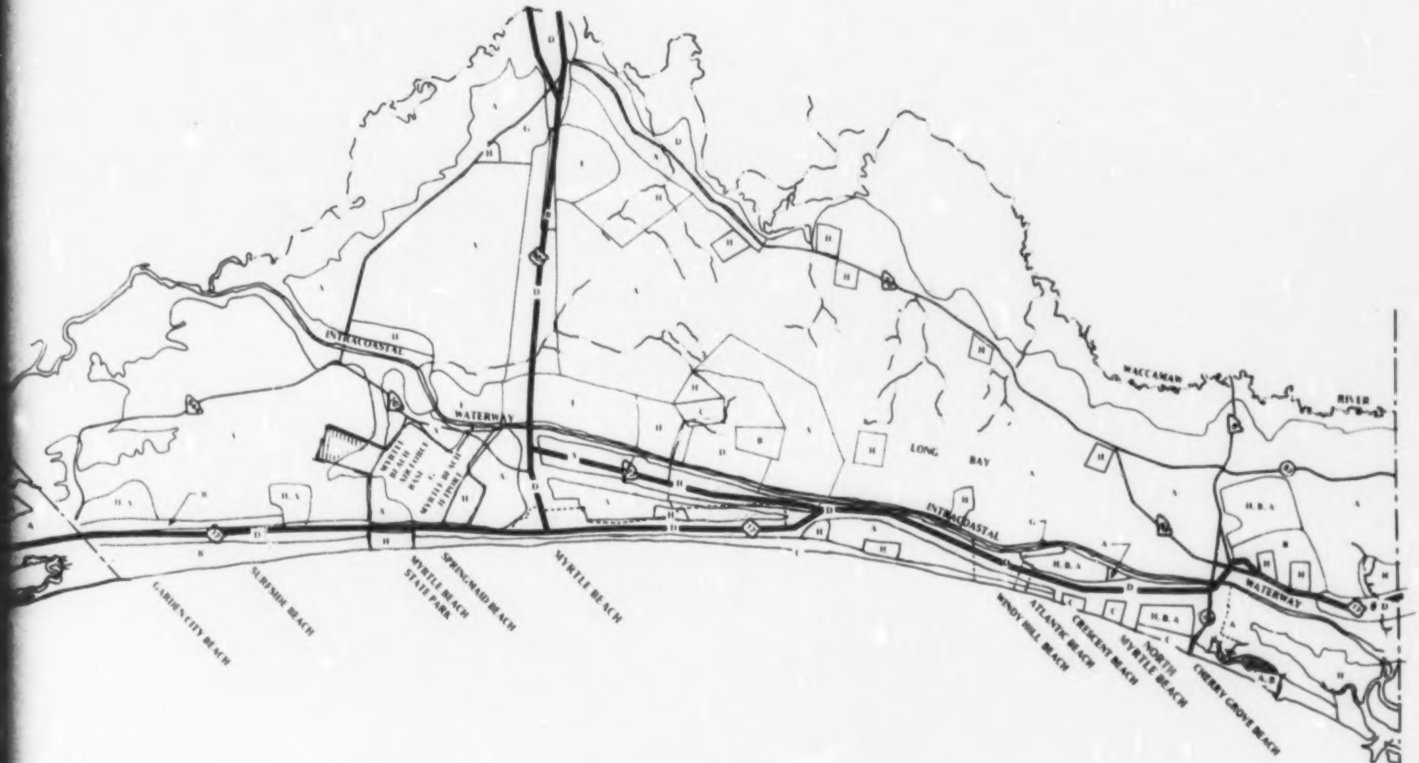

SAMPIT RIVER
PEE DEE
RIVER
WACCAMAW RIVER
SANDY ISLAND
WACCAMAW
RIVER
COASTAL
INTRA
WATERWAY
WINYAH BAY
WACCAMAW NECK
BROOKGREEN GARDENS
HUNTINGTON BEACH STATE PARK
NORTH LITCHFIELD BEACH
LITCHFIELD BEACH
WAVERLY MILLS
PAWLEYS ISLAND
GARDEN CITY
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
LEGEND
A DENOTES LOW DENSITY RESIDENTIAL
B DENOTES MEDIUM DENSITY RESIDENTIAL
C DENOTES HIGH DENSITY RESIDENTIAL
D DENOTES COMMERCIAL
E DENOTES LIGHT INDUSTRY
F DENOTES HEAVY INDUSTRY
G DENOTES INSTITUTIONAL
H DENOTES PARKS & GOLF COURSES
A B DENOTES AGRICULTURAL RURAL
P DENOTES PLANTATION
< 4.7 UNITS PER ACRE
(TO 22 UNITS PER ACRE)
HOTEL MOTEL TO 42 UNITS PER ACRE
MULTI FAMILY HOUSING TO 22 UNITS PER ACRE

FIGURE 3-11
Projected Land Use Map


INTRACOASTAL
WATERWAY
MYRTLE BEACH AIR FORCE BASE
MYRTLE BEACH JETPORT
LONG BAY
INTRACOASTAL
WACCAMAW RIVER
WATERWAY
GARDEN CITY BEACH
SURFSIDE BEACH
MYRTLE BEACH STATE PARK
SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH MYRTLE BEACH
CHERRY GROVE BEACH

In the short run, those areas presently in a holding use, such as campsites, may be redeveloped for expensive primary or secondary housing. Both single family homes and condominium developments should result. One of the first areas where this should take place would be in the Litchfield and Dunes areas. Available coastal tracts probably will be developed for high income housing while lower income developments will be proposed for inland areas.

Several types of development are likely to occur on the Buist Tract. These include a variety of residential densities (up to about 15 dwelling units per acre), as well as office and manufacturing units with open space buffer areas. A planning study for the area conducted by RTKL Associates outlined this type of development. On both the Buist Tract and other tracts in the 201 area, it is expected that manufacturing plants would cluster in industrial parks adjacent to major existing and planned highways.

An awareness of the importance of sound planning is evidenced by recent reports by the WRPDC, by the recent adoption of zoning by Georgetown County and the beach communities previously mentioned, by the construction of the Environs line, and by the 201 proposal itself. Proper planning will assure that the Grand Strand area is developed in a sound and orderly fashion.

3.6 ADMINISTRATIVE AND REGULATORY LAND USE CONTROLS

The types of administrative and regulatory measures available for land use planning and control in the 201 area include:

- Planning
- Zoning
- Subdivision regulation
- Permit requirements for wastewater disposal.

Under South Carolina statutes, local authorities can establish planning commissions and enact planning procedures and zoning and subdivision regulations. The most important of these enabling statutes are:

- The Zoning and City Planning Act

- The County Planning Act

- Act No. 487 (enabling act for planning, zoning, and subdivision regulations)

Planning, in general, occurs throughout the planning area under the auspices of the Waccamaw Regional Planning and Development Council. This Council has coordinated comprehensive planning efforts as well as specific studies on sewer services, fire services, transportation, and land development. The Council, however, has no taxing, legislative or enforcement authority. Achievement of its recommendations often requires the enactment of local regulations.

The Waccamaw Regional Planning and Development Council has encouraged the planning area counties and municipalities to adopt the zoning ordinances and subdivision regulations authorized by state statute. At the present, Georgetown County has adopted both a zoning ordinance and subdivision regulations. Three Horry County municipalities also have adopted both zoning and subdivision regulations, but there are no county-wide regulations.

Georgetown County's zoning ordinance, drafted by WRPDC, includes a provision limiting the height of projects in the Waccamaw neck area to sixty feet. The objective is to prevent high density development in the area adjacent to the Baruch Estate nature preserve. Large portions of the County are zoned for agriculture and will serve as holding zones until conditions permit higher use development. Developers must either obtain a variance or apply for a zoning change in order to develop sites zoned for agriculture. Since the County, therefore, is not committed by ordinance to fixed zones specifying particular types or levels of development, it has considerable latitude in structuring its development.

Horry County has requested the Planning Council's assistance in designing and implementing a zoning ordinance and subdivision regulations. Although these are not enacted yet, Horry County municipalities which have enacted zoning ordinances and subdivision regulations include the City of Myrtle Beach (1970), the Town of North Myrtle Beach (1970), and the Town of Surfside (1973).

The only measure presently applied throughout the 201 planning area is the wastewater permit requirement. Wastewater permits must be secured from the State Department of Health and Environmental Control which can override the conditions of zoning and subdivision regulations if specific projects fail to meet state wastewater disposal standards. This agency has exerted strong regulatory control over new development in the 201 planning area. For example, by denying permits for private wastewater systems, the agency prevented the development of several sites in the southern part of the planning area. The Department of Health also exerted its power in bringing about the cooperation of private developers in North Myrtle Beach in constructing the environs line. This cleared the way for the recent large scale hotel development at North Myrtle Beach.

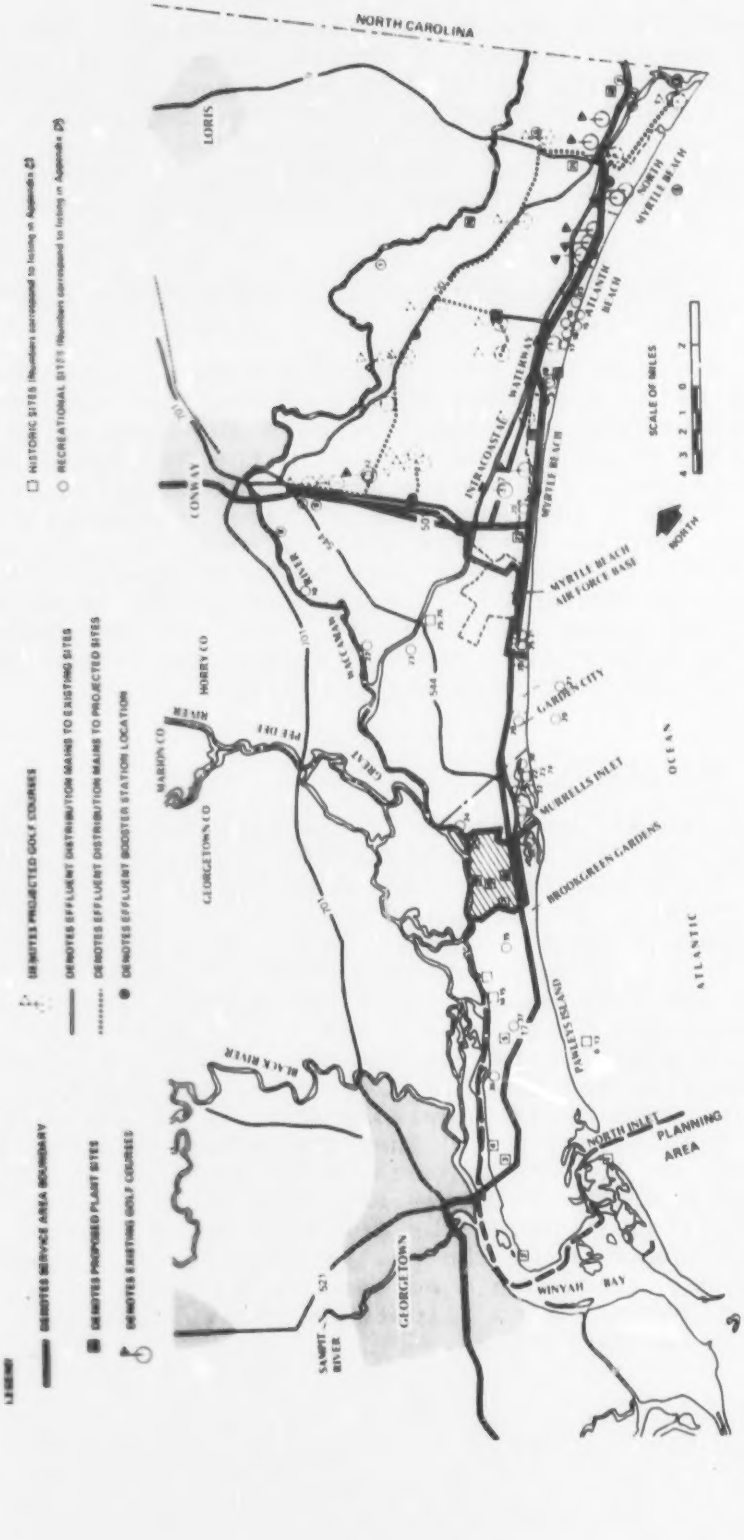
3.7 HISTORICAL, ARCHEOLOGICAL, AND RECREATIONAL RESOURCES

The planning area contains several types of historical sites including houses of architectural significance, plantations, historic churches and cemeteries, and several sites which played a role in the Revolutionary War or the Civil War. The area's archeological sites are numerous and vary in importance. There is evidence of Indian camps and Confederate earthworks as well as two mounds, recently discovered just north of Georgetown (outside the planning area), which may be the remains of a 4,500-year-old Mayan civilization. The sections below describe the historical, archeological, and recreational resources of the area in greater detail.

3.7.1 Historical Sites

Several properties in the planning area have been included in the National Register of Historic Places, according to the South Carolina Department of Archives and History. These properties are known as the Pawley's Island Historic District and are shown by sites 6 through 13 in Figure 3-12. Two properties which are under review for inclusion in the National Register are Hobcaw Barony and Arcadia Plantation, properties 2 and 4 in Figure 3-12. Four historical places located within the boundaries of Brookgreen Gardens (outside the 201 planning area) are awaiting National Register approval by the Advisory Council on Historic Preservation in Washington, D.C. They are shown as sites 18 through 21 in Figure 3-12. The Department of Archives and History, in cooperation with the Waccamaw Regional Planning and Development Council, has updated the descriptions of historic sites which appeared in the Master Plan for the proposed action. These sites are described in Appendix I and are mapped in Figure 3-12 to illustrate their location in relation to the proposed facilities.

FIGURE 3-12
Historical Sites


LEGEND
DENOTES SERVICE AREA BOUNDARY
DENOTES PROPOSED PLANT SITES
DENOTES EXISTING GOLF COURSES
DENOTES PROJECTED GOLF COURSES
DENOTES EFFLUENT DISTRIBUTION MAINS TO EXISTING SITES
DENOTES EFFLUENT DISTRIBUTION MAINS TO PROJECTED SITES
DENOTES EFFLUENT BOOSTER STATION LOCATION
HISTORIC SITES (Numbers correspond to listing in Appendix 2)
RECREATIONAL SITES (Numbers correspond to listing in Appendix 2)
NORTH CAROLINA
LORIS
CONWAY
NORTH MYRTLE BEACH
ATLANTIC BEACH
INTRACOASTAL WATERWAY
MYRTLE BEACH
MYRTLE BEACH AIR FORCE BASE
SCALE OF MILES
4 3 2 1 0 2
NORTH
WACCAMAW RIVER
HORRY CO
MARION CO
GREAT PEE DEE RIVER
GEORGETOWN CO
GARDEN CITY
MURRELLS INLET
BROOKGREEN GARDENS
PAWLEYS ISLAND
ATLANTIC OCEAN
BLACK RIVER
GEORGETOWN
SAMPIT RIVER
WINYAH BAY
NORTH INLET
PLANNING AREA
501
544
701
521

3.7.2 Archeological Sites

The Institute of Archeology and Anthropology of the University of South Carolina has located and described 25 archeological sites which have been considered in the design of the proposed facilities. Descriptions of these sites are provided in Appendix E and their locations, in relation to the proposed facilities, are mapped in Figure 3-13 While a few of these sites appear very close to some segments of the proposed wastewater transmission lines, the sites are not in the path of any of the proposed lines. Other archeological sites probably exist in the planning area because detailed surface investigations have not been made for the vast majority of land in the planning area.

3.7.3 Recreational Resources

The planning area's valuable recreational and natural resources lure vacationers from many regions of the United States and serve as the area's economic base. The area's major recreational resources and support facilities are shown in Figure 3-14.

The area offers many and varied recreational areas for golf, bathing, tennis, boating, fishing, camping, and hunting. To complete its well-rounded recreational attractions, the area also boasts a number of unusual features which are sightseeing and cultural attractions. Two such features are Brookgreen Gardens and the Atalaya House in Georgetown County.

The most popular recreational areas are those in which natural environmental features provide the main attraction. Such areas include the 57-mile-long beach; the ocean bays, inlets, and rivers; state parks; and game management areas.

The most significant areas developed for recreational activities are the regions's 30 golf courses. In 1973, those golf courses totaled approximately 578,000 paid rounds of golf, providing major inputs to the area's economy.* Golf courses also affect the character of area land use by preserving vast acreages of open space which are often part of well planned residential areas. A few golf courses have preserved some of the area's Carolina Bays as well. In some

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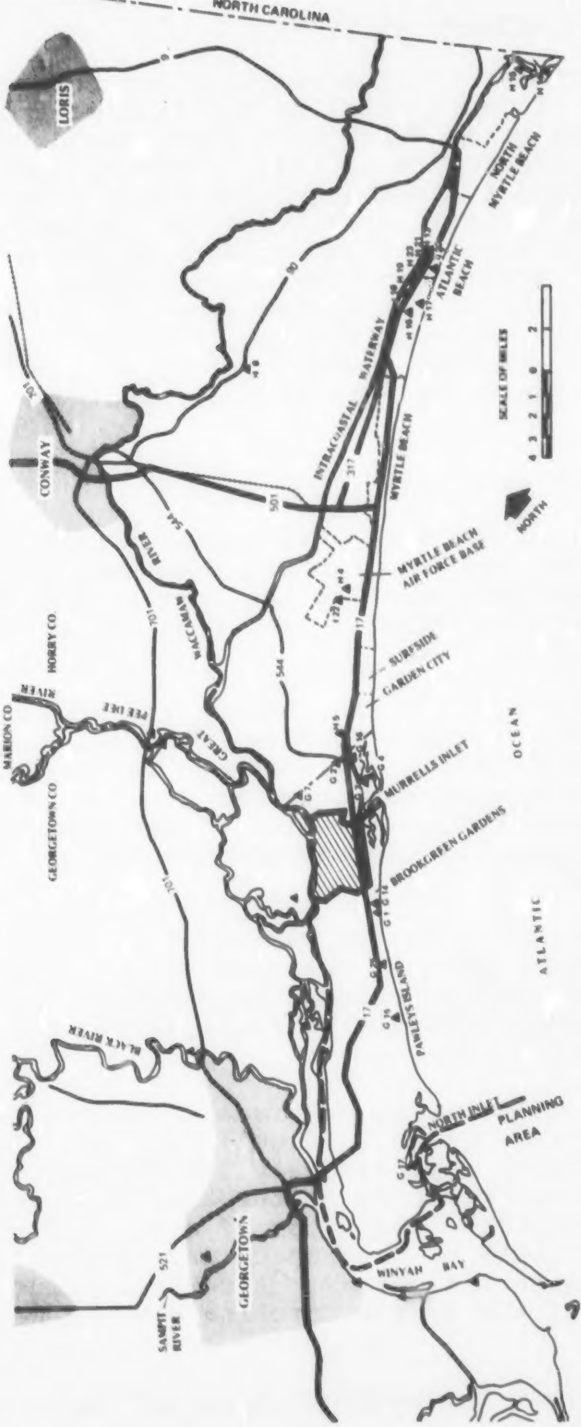
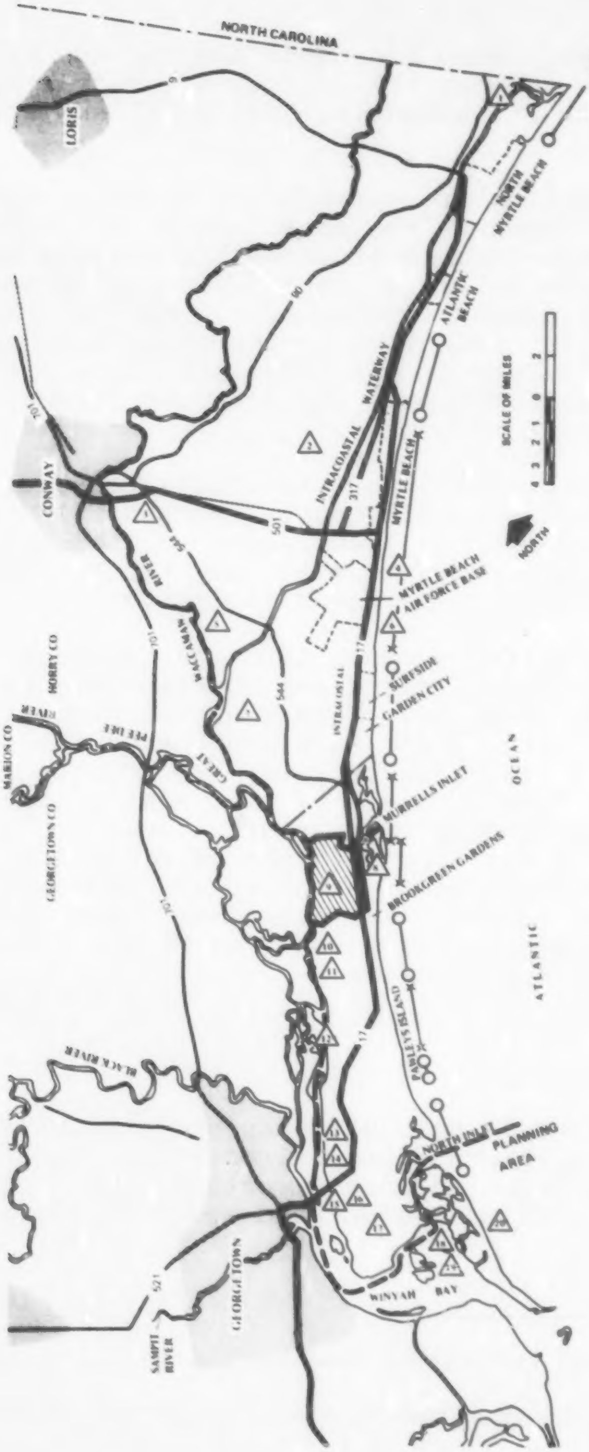
* Horry County Development Planning and Tourism Commission

FIGURE 3-13
Archeological Sites


NORTH CAROLINA
LORIS
9
90
NORTH MYRTLE BEACH
ATLANTIC BEACH
INTRACOASTAL WATERWAY
MYRTLE BEACH
SCALE OF MILES
4 3 2 1 0 2
NORTH
CONWAY
701
501
544
17
MYRTLE BEACH AIR FORCE BASE
SURFSIDE
GARDEN CITY
HORRY CO.
WACCAMAW RIVER
MARION CO.
GREAT PEE DEE RIVER
GEORGETOWN CO.
MURRELLS INLET
BROOKGREEN GARDENS
ATLANTIC OCEAN
PAWLEYS ISLAND
BLACK RIVER
NORTH INLET PLANNING AREA
GEORGETOWN
WINYAH BAY
521
SAMPIT RIVER

▲ = Archeological Sites

FIGURE 3-14
Recreational Sites


NORTH CAROLINA
LORIS
9
90
CONWAY
501
NORTH MYRTLE BEACH
ATLANTIC BEACH
INTRACOASTAL WATERWAY
317
MYRTLE BEACH
SCALE OF MILES
4 3 2 1 0 2
NORTH
MYRTLE BEACH AIR FORCE BASE
WACCAMAW RIVER
544
HORRY CO
MARION CO
GEORGETOWN CO
GREAT PEE DEE RIVER
701
SURFSIDE
GARDEN CITY
MURRELLS INLET
BROOKGREEN GARDENS
17
PAWLEYS ISLAND
ATLANTIC OCEAN
NORTH INLET
PLANNING AREA
BLACK RIVER
WINYAH BAY
GEORGETOWN
521
SAMPIT RIVER

cases, these bays have been modified for use as lakes, a practice which changes the ecology of the bay somewhat but which preserves its essential geological and surface characteristics.

Campsites are examples of another type of existing natural environment in the area, modified for recreational purposes. Short-term environmental losses in the development of campsites are tolerated to gain long-term benefits from use of the surrounding environment. Many of the area's campsites are located close to the ocean beaches, while others are developed around lakes and ponds. Currently, about 8,000 campsites make the area the largest center of family camping in the world.*

Most expansion of the area's recreational facilities will be commercial developments. At least 18 new golf courses, totaling about 1,400 acres in land consumption, are planned. Other developments may include thousands of campsites and major new tennis facilities.

The State of South Carolina, through its Horry County Development Planning and Tourism Commission, Department of Parks, Recreation, and Tourism, plans improvements to Huntington Beach State Park and has developed a master plan for Myrtle Beach State Park. In addition, the Department is considering a piece of land near Little River Inlet for possible development as a park. However, acquisition of this land is not likely in the near future. In addition the State's Department of Archives and History, through its Heritage Trust Program, has determined that the presently undisturbed dunes and marshlands of Waites Island are well suited as a park site.

3.8 TRANSPORTATION

The Grand Strand transportation system is composed of highways, airports, the railroad, and the Intracoastal Waterway. Highways are the most important part of the system, carrying the bulk of freight and about 98 percent of the tourists.**

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* Horry County Development Planning and Tourism Commission

** Horry County, Development, Planning and Tourism Commission.

Jet service to the new civilian facility at Myrtle Beach Air Force Base has augmented air travel capacity. Although, the service is too new for an assessment of its impact, it will increase the area's accessibility to high-income tourists and retirees. Air freight accounts for a limited amount of goods shipped to and from the area.

The only rail carrier to the area, Atlantic Coastline Railroad, has no passenger service and carries only a few specialized goods. Its alignment along Route 501 does, however, provide ready access.

The Intracoastal Waterway provides a transport route for two large local users: a major paper company in Georgetown and a plywood company in Conway. Most users of the waterway are on interstate trips, and do not stop in the area.

No public transit system exists in the planning area. A three-phase study was terminated after completion of the first phase because local authorities did not wish to develop mass transit systems.

The remainder of this section is organized into the following sections:

- Highway Traffic
- Air Traffic
- Planned and Projected Transportation Facilities.

3.8.1 Highway Traffic

Roadway improvements have not kept pace with the growth of the planning area. As a result, the existing roadway system does not adequately carry the traffic during the peak period of the tourist season.*

- U.S. Route 17 parallels the beach through the urban areas along the Grand Strand.
- U.S. Route 501 provides the major connection from Route 17 to Interstate 95 for northern access.

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* "Corridor Location Study, Florence-Grand Strand Area," Wilbur Smith and Associates, January 1973.

- U.S. Route 378 provides southern access to the area from Interstate 95 by connecting Interstate 95 to Route 501 at Conway.
- South Carolina Routes 9 and 917 provide access to the northern end of the Grand Strand.

U.S. Routes 501 and 378, the heaviest traffic carriers, exhibit almost identical hourly traffic flow patterns: a rapid, continuous increase in traffic volume from 5:00 A.M. to noon followed by a continuous decline until midnight. The peak hour, noon, corresponds to checkout times at lodgings along the Grand Strand. The intersection of Routes 501 and 378 operates beyond design capacity, resulting in long delays for beach traffic on weekends.

Traffic flow into the beach area greatly depends on traffic distribution along the Grand Strand. The recent completion of the Myrtle Beach bypass, Bryan Drive, has stimulated traffic flow to the beach and relieved some of the congestion at Conway. This new road also serves to alleviate traffic congestion in downtown Myrtle Beach.

The maximum volume possible, before unsuitable flow conditions occur on Routes 378 and 501, is about 15,000 vehicles per day. This maximum volume can be obtained only with high density, slow and uniform operation, and inability to pass.* During August 1974, the average 24-hour weekday traffic on Route 501, between Conway and Myrtle Beach, was over 20,000 vehicles per day, indicating congested conditions. Other average 24-hour weekday traffic volumes for four major roads in the planning area are:

- Route 17 from Georgetown to Georgetown-Horry County line, 10,000 vehicles per day
- Route 17 within city limits of Myrtle Beach, about 30,000 vehicles per day
- Route 17, North Myrtle Beach area, about 16,000 vehicles per day

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* "Corridor Location Study, Florence-Grand Strand" Wilbur Smith Associates, January 1973.

- Route 17, north of Route 90-9-17 interchange, about 12,000 vehicles per day
- Route 90, south of Route 90-9-17 interchange, about 2,600 vehicles per day
- Route 544, at bridge across Intracoastal Waterway, about 5,900 vehicles per day.

The number of miles traveled by motor vehicles per day, in vehicle miles traveled (VMT), is a useful traffic measurement and is used in estimating the component of air pollution attributable to motor vehicles. Summaries of VMT for the planning area for 1972 and projections for 1995 are shown in Table 3-13.

Table 3-13
Daily Traffic on Existing Grand Strand Area Transportation Study (GSATS) Street System*

Type Facility	1972 VMT	Projected 1995 VMT
Principal Arterial	1,021,252	2,003,786
Minor Arterial	85,313	370,435
Collector	135,549	543,440
Total	1,242,114	2,917,661
Area		
Myrtle Beach	537,158	1,120,667
North Myrtle Beach	245,757	688,027
Surfside, Garden City & Murrells Inlet	315,127	792,754
Litchfield, Pawley's Island & Georgetown Area	146,417	321,755

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* South Carolina State Highway Department, Office of Advanced Planning.

3.8.2 Air Traffic

The major airports in the planning area are the Myrtle Beach Airport, located next to the Intracoastal Waterway in the Crescent Beach area, and the Myrtle Beach Air Force Base, located just south of Myrtle Beach. Activity at Myrtle Beach Airport has increased markedly in the past few years. Total operations increased from 23,948 in 1969 to 38,975 in 1973 a 62.7 percent increase. For the same period, passengers boarding the only scheduled air carrier, Piedmont, increased from 15,695 to 38,181; a 143 percent increase. Piedmont regards the Myrtle Beach area as the fastest growing destination in its system.

The Air Force base and the City of Myrtle Beach have an agreement whereby a portion of the air base is used for commercial carrier service. Jet service to the new civilian facility started in July 1975. The "Master Plan for the Myrtle Beach Airport"* calls for shifting of all scheduled air carrier, executive jet, and large charter aircraft from Myrtle Beach Airport to the new civilian facility at the air base. This shift is largely complete, freeing Myrtle Beach Airport for general aviation use and limiting the major noise producing aircraft to the air base. The shift of commercial carrier service to the air base has other important consequences for the planning area:

- Avoidance of major disruption to the area near the existing Myrtle Beach Airport from construction of new facilities which would have been required to handle growth in air traffic
- Improved access to air carrier service by the general public because the new civilian airport is located near the center of the area's population.

Bryan Drive, the newly completed Myrtle Beach bypass road, should improve general access to both the civilian facility at the air base and to Myrtle Beach Airport. The extension of Bryan Drive from Route 501 to Route 17 (Business) near Murrells Inlet, scheduled to begin construction in early 1977, should also improve overall access to these airports.

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* Talbert, Cox & Associates, February 1974.

3.8.3 Planned and Projected Transportation Facilities

New transportation projects will include highway expansion and construction and airport improvements. There are no significant plans to develop railway, waterway, or mass transit facilities.

Currently, there is no major highway construction in the planning area. However, construction will begin soon on the Bryan Drive extension. This project will extend the northern leg of Bryan Drive from Route 501 to U.S. 17 (Business) near Murrell's Inlet. The project will decrease congestion on Route 501 and Route 17, especially in and near downtown Myrtle Beach, and will increase public access to the new civilian airport at the Air Base.

Additional long term highway plans, recommended in the Grand Strand Area Transportation Study, include the extension of 17th Avenue south in Myrtle Beach, the construction of the Hillside Connector in North Myrtle Beach, and the widening of U.S. 17 and several smaller roads. The new projects will use existing rights of way. However, the high price of real estate may preclude development of these new projects which would require the purchase of new rights of way.

Airport improvements are scheduled for the new civilian facility at the air base including expanded parking facilities and a permanent terminal. The airport master plan calls for planning for a second general aviation airport for the area as soon as operations at Myrtle Beach Airport reach 60 percent of capacity, now projected to occur around 1985.

3.9 RESOURCE CONSUMPTION

This section describes the types, quantities, and qualitites of natural resources and power resources consumed in the planning area in recent years. Projections of quantities of power resources are not made by the suppliers. The only projections of natural resource consumption, made by suppliers, are those for commercially harvested pine, which were not available for this report.

3.9.1 Major Natural Resource Users

The largest users of the planning area's natural resources are the pine harvesters. A large plant in

Georgetown converts raw timber to pulp and paper. This plant accounts for a large percentage of Georgetown County's manufacturing employment.

The next most important extractors of the area's natural resources are the organic clay mines; a 500-acre site at the intersection of Route 501 and the Intracoastal Waterway. The clay is cut from a deposit which has a maximum depth of about 15 feet and is manufactured on-site, primarily into bricks.

The area also contains a sand-clay mixture which is extracted from several deposits, the most important of which is Gravelly Gully near Socastee. The mixture is an important resource for local road construction. Its depletion would result in significant road construction cost increases, because the raw material would have to be hauled from more remote parts of Horry and Georgetown Counties.

The commercial fishing and shellfishing industries are the most significant commercial users of area water resources.

3.9.2 Electric Power Use

The South Carolina Public Service Authority is responsible for nearly all electric power generation and distribution. Its principal generating stations are:

- Grangier steam electric plant at Conway, 150 megawatt
- Gas turbine generator at Myrtle Beach, 0.09 megawatt (standby system)
- Georgetown I steam electric of Georgetown, 300 megawatt.

Interconnections with other systems are maintained. Plans for expansion of supply include:

- Tie-in to nuclear plant west of Columbia, South Carolina
- Georgetown II steam electric at Georgetown, 300 megawatt, 1978.

All steam electric plants above use bituminous coal as fuel. Improvements to the distribution system under construction or in planning stage include:

- New 230 kv station south of Route 501 between Conway and Myrtle Beach
- Transmission line from station above through Buist Tract and Buist Game Management area to the north end of Myrtle Beach, 1977
- Transmission line from station above to Garden City, 1975
- Transmission line (230 kv) from station above to Kingstree, South Carolina; clearing of right of way in progress
- Transmission line (115 kv) from station above to Georgetown I and II plants, under construction.

Electric energy consumption in the planning area has grown rapidly during the past ten years. The peak consumption rate, which usually occurs annually in July, increased from 52 megawatts in 1965 to 180 megawatts in 1975. A breakdown of electric power consumption by major user type for 1974 is provided in Table 3-14 below:

Table 3-14
Electric Power Consumption, 1974*

User	Millions of Kilowatt Hours
Motels, commercial	289.9
Residential	223.5
Industrial	43.5
Public facilities	3.7
Other (temporary service, construction service, water and sewer)	6.1
Total	566.7

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* South Carolina Public Service Authority

Energy conservation programs have had a noticeable effect on consumption in the area, with the Air Force base leading in conservation among major users. The rapid increase in power generation costs and rates in the past two years has induced conservation by industries.

3.9.3 Natural and Liquefied Petroleum Gas Use

The Carolina Pipeline Company supplies natural gas to the area using a main which follows Route 501 from Conway to Myrtle Beach.

The distribution system, from the Air Force base to 80th Avenue in Myrtle Beach, serves motels, commercial laundries, residences, and industry. In 1975, these users consumed about 100 million cubic feet per day. The estimated past and projected annual rate of increase in consumption is 10 percent for the period 1965 to 1985. No new expansion of the existing gas main along Route 501 is planned, but expansion of the distribution network will continue.*

Liquefied petroleum (LP) gas is supplied to the planning area by about ten distributors from Georgetown, Conway, and Myrtle Beach. The main users of LP gas are residences, commercial establishments, and recreational vehicles. Limited use of it occurs in tobacco drying and in carburetion of cars and trucks. Total annual consumption in 1975 was about 300,000 gallons, with the estimated past and projected rate of increase in consumption at 10 percent for the period 1965 to 1975.**

3.9.4 Fuel Oil Use

Between November 1975 and November 1976, 5,790,000 gallons of fuel oil were sold on the Grand Strand. Approximately 50 percent was kerosene and 50 percent Number 2 fuel oil. Fuel oil use has been rising 12-13 percent annually, despite the energy crisis, because of the area's continued growth. The fuel oil is used almost exclusively for home heating.

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* Carolina Pipeline Company

** Pyrofax Gas Corporation, Conway, South Carolina

3.10 COMMUNITY SERVICES

The residents of the planning area receive community services through a combination of state, county, and municipal agencies. In general, state and county governments provide health and welfare, education, and highway services. Municipal and county agencies usually share water supply, wastewater treatment, public safety, solid waste treatment, and administration services. Table 3-15 provides details on community services, including:

- Level of government responsibility
- Manpower
- Physical structures
- Revenue collection.

Identification of the existing extent of services is difficult because much of the 201 planning area is unincorporated. Of the total planning area of about 400 square miles, municipalities have jurisdiction only over approximately 20 square miles. A recent Waccamaw Regional Fire Protection Study shows that in the three county Waccamaw region, 17 distinct governmental and volunteer units operate. Coordinated, county-wide fire protection systems do not exist. Large parts of both the Georgetown and Horry County sections of the planning area are not covered by existing fire departments and generally receive no fire protection services. In Georgetown County, approximately 39.7 percent of the population and 42.1 percent of its housing units are unprotected. In Horry County, 63.5 percent of the population and 45.8 percent of the housing units are unprotected. Not only is the extent of services low, but the equipment is not entirely adequate.

Assessment of the current level and adequacy of other community services is difficult. Detailed statistics are unavailable, and the factors contributing to the inadquacy of fire protection services do not necessarily have the same impact on police, schools, libraries and health care. For example, firefighting services are inadequate because no countyside fire protection service covers the unincorporated land. By contrast, the county administers the school system and health services, and augments local police services with a county sheriff and county police department. Since there are no widely accepted standards for many types of community services, each community must assess the adequacy of its own services on the

Table 3-15
Community Services

	Level of Government Responsible	Total Manpower	Manpower per 100 Population	Important Physical Structures	Revenue Collection Method
Transportation					
. Mass transit	None				
. Roads	State Hwy. Comm. County Comm.	174	2.2	Two 4 lane high level bridges over Intracoastal Waterway	State & Federal gasoline tax
Water Supply	Municipalities Grand Strand Water and Sewer Auth.	61	.76	31 high level storage tanks	Tap fees and meter billing
Wastewater Treatment	Municipalities Grand Strand Water and Sewer Auth.	10	.125	(2) 30 acre oxidation ponds (several smaller)	Sewer charges
Public Safety					
. Fire Protection	Municipalities	59	.73		City taxes
. Police	Municipalities and Counties	116	1.45	New law enforcement bldg. (from revenue sharing)	City taxes and fines
Public Works					
. Solid Waste	Municipalities	78	.95	146 acre land fill	County & City Tax, County bds. for new solid waste transf. & compaction sta.
. Other	and County	18	.225		
Schools	State Dept. Ed. County Dept. Ed.	.240	15.5	Coastal Carolina Regional Campus Horry-Georgtn. Tech. Ed. Center (8) High school bldgs.	State sales tax County millage levy
Libraries	County Colleges	20	.250	(2) Library bldgs.	County millage levy
Health & Welfare	State County	140	1.75	(3) Health Centers Conway Hospital, Oceanview Memorial Hospital	County millage levy
Administrative	Municipal	144		Court House	County millage levy
	County		1.8	New County Office Bldg.	

basis of population density, age distribution, existing crime rate, types of dwelling, population mobility and transience.*

Overviews of county and municipal government fiscal capabilities follow:**

- Horry County is governed by a seven-member board of county commissioners and has bonded indebtedness of $905,000 in general obligation bonds and $2,115,000 in school bonds.
- Myrtle Beach has a council-manager form of government and bonded indebtedness of $695,000 in general obligation bonds for construction of the Myrtle Beach Convention Center and sewer facilities and $735,000 in water and sewer revenue bonds.
- North Myrtle Beach has a council-manager format government with a bonded indebtedness of $1,016,000 in general obligation bonds and $1,003,000 in water and sewer revenue bonds.
- Surfside Beach has a mayor-council form of government with bonded indebtedness of $275,000 in general obligation bonds for water works improvements and $233,000 in water revenue bonds.

3.11 OTHER MAJOR PROJECTS IN THE PLANNING AREA

In addition to the proposed regional wastewater facilities, other projects with regional impact which have been undertaken or are being planned include community support facilities, housing, waste disposal facilities, improved environmental data base projects, and Corps of Engineers Projects. These projects and their impact on the planning area are described below. Figure 3-15 shows the locations of planned projects.

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* International Association of Chiefs of Police

** National League of Cities/Conference of Mayors

*** Waccamaw Regional Planning and Development Council

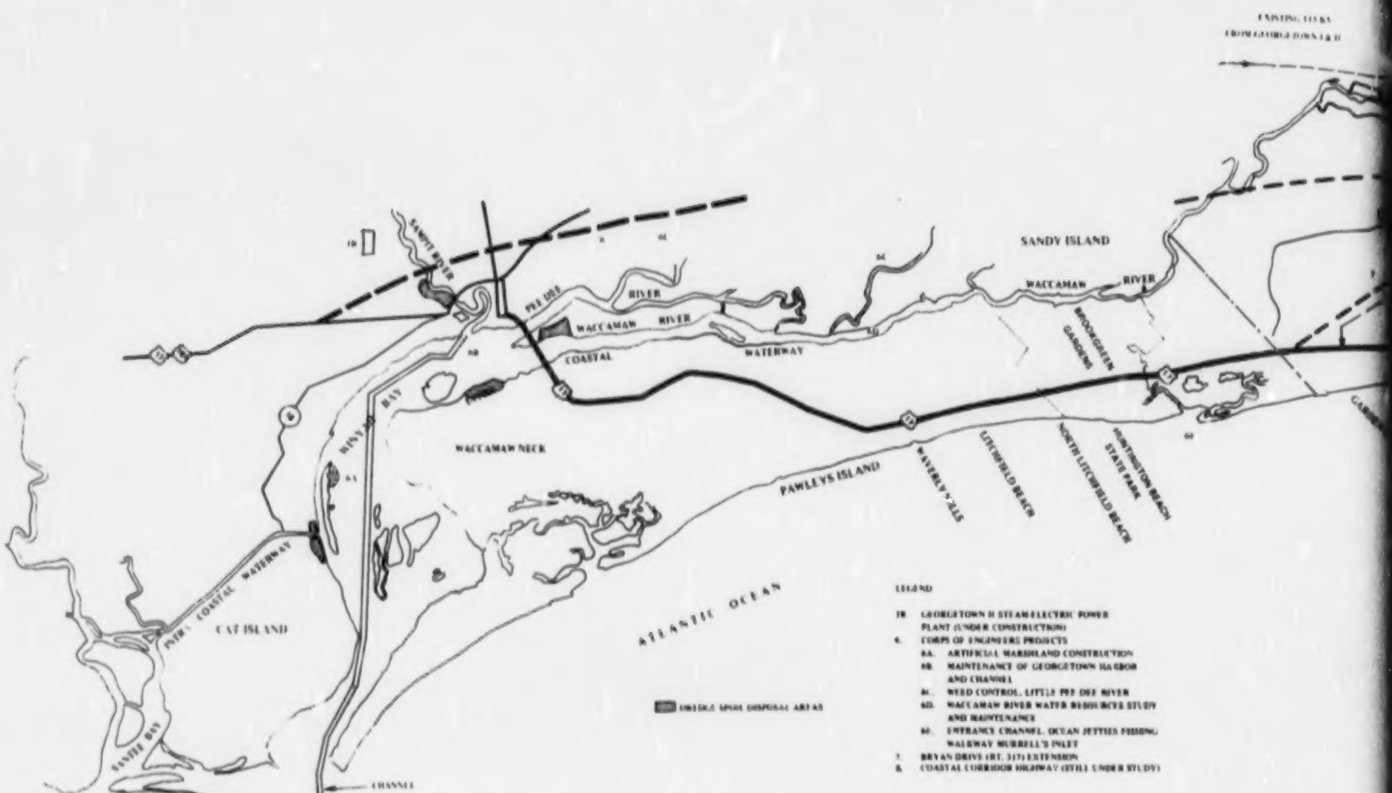
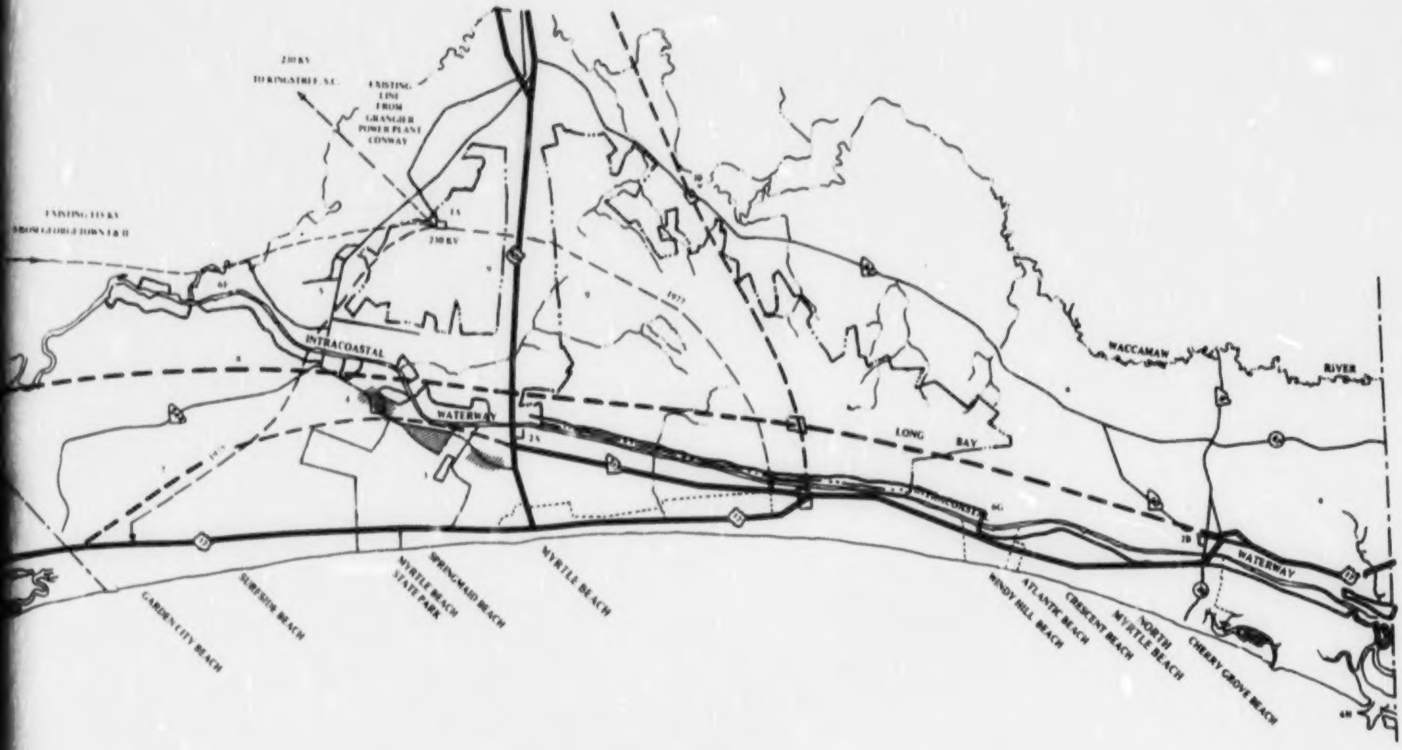

EXISTING 115 KV
FROM GEORGETOWN I & II
SAMPIT RIVER
PEE DEE RIVER
WACCAMAW RIVER
COASTAL WATERWAY
SANDY ISLAND
WACCAMAW RIVER
BROOKGREEN GARDENS
HUNTINGTON BEACH STATE PARK
NORTH LITCHFIELD BEACH
LITCHFIELD BEACH
WAVERLY MILLS
PAWLEYS ISLAND
WACCAMAW NECK
WINYAH BAY
INTRA COASTAL WATERWAY
CAT ISLAND
SANTEE BAY
ATLANTIC OCEAN
CHANNEL
DREDGE SPOIL DISPOSAL AREAS
LEGEND
5B. GEORGETOWN II STEAM-ELECTRIC POWER PLANT (UNDER CONSTRUCTION)
6. CORPS OF ENGINEERS PROJECTS
6A. ARTIFICIAL MARSHLAND CONSTRUCTION
6B. MAINTENANCE OF GEORGETOWN HARBOR AND CHANNEL
6C. WEED CONTROL, LITTLE PEE DEE RIVER
6D. WACCAMAW RIVER WATER RESOURCES STUDY AND MAINTENANCE
6E. ENTRANCE CHANNEL, OCEAN JETTIES FISHING WALKWAY MURRELL'S INLET
7. BRYAN DRIVE (RT. 317) EXTENSION
8. COASTAL CORRIDOR HIGHWAY (STILL UNDER STUDY)

FIGURE 3-15
Major Planned Projects


230 KV
TO KINGSTREE, S.C.
EXISTING
LINE
FROM
GRAINGER
POWER PLANT
CONWAY
EXISTING 115 KV
FROM GEORGETOWN
1A
230 KV
INTRACOASTAL
WATERWAY
2A
LONG BAY
WACCAMAW RIVER
6G
2B
WATERWAY
GARDEN CITY BEACH
SURFSIDE BEACH
MYRTLE BEACH
STATE PARK
SPRINGMAID BEACH
MYRTLE BEACH
WINDY HILL BEACH
ATLANTIC BEACH
CRESCENT BEACH
NORTH
MYRTLE BEACH
CHERRY GROVE BEACH
6H

LEGEND

1A. ELECTRICAL POWER TRANSMISSION IMPROVEMENTS
APPROXIMATE ROUTES FOR NEW LINES
2A., 2B., PROPOSED SOLID WASTE COMPACTION AND TRANSFER STATIONS
3. MYRTLE BEACH JETPORT
4. WATER AND SEWER PROJECT, HUD
5. WATER SUPPLY PROJECT, HUD
6. CORPS OF ENGINEERS PROJECTS
  6F. MAINTENANCE OF INTRACOASTAL WATERWAY
  6G. REEVALUATION OF NEED FOR DISPOSAL AREAS
  6H. LITTLE RIVER INLET CHANNEL MAINTENANCE
7. BRYAN DRIVE (RT. 317) EXTENSION
8. COASTAL CORRIDOR HIGHWAY (STILL UNDER STUDY)
9. DUBT TRACE DEVELOPMENT (STILL UNDER STUDY BY PRIVATE DEVELOPER)
10. FLORENCE - GRAND STRAND CORRIDER HIGHWAY (STILL UNDER STUDY)

3.11.1 Community Support Projects

New highways and airport facilities will provide tourists with easier access to existing and planned facilities, especially the new convention center and the ever-increasing number of golf courses. Such improved accessibility to the area will provide a stimulus to the area's growth. An interesting interaction is the one between the new civilian jet airport facilities of Myrtle Beach Air Force Base and the Myrtle Beach Convention Center. Surveys have shown that some convention groups may have avoided the resort in the past because of its lack of jet service.* The new jet service is also expected to attract more high-income tourists and permanent residents.

The South Carolina State Highway Department has undertaken the Grand Strand Area Transportation Study (GSATS) which will recommend a master transportation plan for the planning area projected to the year 1995. The plan, scheduled for completion by December 1976, will be tested for air quality impact. Its total impact on the area will be evaluated by the citizens, in conjunction with elected officials of the study area.** Recent highway improvements, such as the widening of Route 501 and the construction of the Myrtle Beach bypass, Bryan Drive, have reduced but have not eliminated traffic congestion in Myrtle Beach.

A mass transit system feasibility study was conducted for the WRPDC, which explored alternatives for developing public transit between the towns of North Myrtle Beach, Myrtle Beach, and Surfside. The three towns decided not to develop a mass transit system.

3.11.2 Housing

The development of the 40,000-acre Buist Tract as a planned community would have a great impact on the planning area. The tract now is almost entirely undeveloped, and is devoted to commercial foresting and game management. Current plans call for overall control of the large area's development by one company according to the company's master plan.

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* "The Master Plan for the Myrtle Beach Airport," Talbert, Cox & Associates, Feb. 1974.

** South Carolina State Highway Department Advance Planning Office

The plan calls for a mix of large-lot residential, limited commercial, light industrial, and office park uses. Retention of control of the tract's development by the single company, according to the plan, might contribute to the orderly development of the area. Such development would curtail the existing use of much of the tract as a privately owned game management area. However, it would preserve large open spaces and native vegetation and add new fresh water ponds to the area through stormwater management operations. Parts of the tract would be preserved for commercial foresting.

3.11.3 Waste Disposal Facilities and Plans

In coping with waste disposal problems, the following studies have been undertaken, which interact with the proposed action:

- The areawide waste management plan, or 208 study, recently initiated by WRPDC, will address nonpoint source pollution problems in the area and will use the proposed wastewater treatment plan as a step toward a longer range regional wastewater plan.
- A comprehensive solid waste management plan is currently the responsibility of the Horry County Ecological Commission, which will determine the suitability of landfill disposal sites in the area and formulate policies for the acceptance of sludge and screened-out solids from the sewage treatment plants of the planning area. Such policies are critical to the disposal of sludge from the proposed facilities, especially if suitable arrangements cannot be made with the owners of golf courses for disposal on selected golf course sites.

New waste treatment and waste management facilities already planned include:

- Myrtle Beach Environs Sewer System, an eight-mile-long interceptor, will provide service to a number of important permanent residential and tourist areas such as the Hilton Hotel, Holiday Inn Trailer Park, Lake Arrowhead, and Briarcliff, and will eliminate their inadequate treatment systems. This system, under the 201 plan, will connect first to the municipal treatment plants of Myrtle Beach and then to the regional system. The system will serve as a pressure sewer for treatment plant A, which will serve the bulk of the northern half of the planning area.

- Two wastewater treatment plants at North Myrtle Beach are currently being upgraded and will be part of the regional system until 1977. They will be phased out; one in 1977 and the other in 1982.

- A HUD-sponsored project will provide $1.25 million for water and sewer service by mid-October 1975 for several communities which lie to the west of Myrtle Beach Air Force Base. The sewage collectors of this project will tie into a transmission line proposed under the 201 plan which will convey wastes to the proposed treatment plant G.

- A solid waste collection and compaction station, proposed for a site in the northeast quadrant at the intersection of the Intracoastal Waterway with Route 501, will provide a central unloading point for the planning area's solid-waste-collecting trucks. This facility will have no real interaction with the proposed facilities of the 201 plan.

3.11.4 Environmental Studies

Inventories of environmental data have been underway for approximately two years for various purposes, ranging from regional surveys to small-area ecosystem studies. The more important regional surveys include:

- A joint USGS-South Carolina Water Resources Commission project to investigate the geology and hydrology of the planning area which has as its goals to:
  - Determine source of chlorides in groundwater
  - Locate groundwater recharge areas and determine recharge rates

    - Determine causes of variations in groundwater quality

    - Determine quantity of groundwater available for potable supplies.

  The results of this study were not available during the EIS study.

- Several environmental inventories in progress, under the recently initiated coastal zone management plan for South Carolina:

    - Vegetative cover map
    - Animal types
    - Sensitive natural areas.

- A United States Soil Conservation Service project that will yield a detailed soils map of the planning area.

The Belle W. Baruch Institute, located on several plantations in the southern part of the planning area, has initiated several small-area ecosystem studies involving:

- Aerial photography interpretation

- Mathematical model of North Inlet

- Marshland micro-ecosystem

- Forest ecology

- Wild hogs

- Song birds

- Endangered species

- Beach erosion stabilization

- Water table survey in small area north of Hobcaw Plantation to monitor changes in groundwater and correlate changes to man-made and natural phenomena.

Together, the regional surveys and small-area ecosystem studies will make significant improvements to the planning area's environmental data base.

3.11.5 Corps of Engineers Projects

The Corps of Engineers is involved in several projects in and around the planning area, most of which are aimed at maintaining navigation channels. The locations of these projects are designated GA through GH in Figure 3-15, and descriptions are provided below:

- Artificial Marshland Construction, 6A. During routine dredging of Winyah Bay in 1974, dredged material was pumped to the location shown in Figure 3-15 and was contained in the area by weighted polyester material curtains. This is planned to be a continuing operation.
- Georgetown Harbor Maintenance, 6B. The Corps completed the Georgetown Harbor Project in 1952 and has performed annual maintenance dredging since then. In May 1975, the Corps issued an environmental impact statement on its proposed changes to annual dredging operations. Channel dredging would be semi-annual instead of annual, and dredging depth would be increased from 29 feet to 31 feet in some locations.
- Aquatic Plant Control, Little Pee Dee River, 6C. Alligator weed is the principal target of this program, which requires one or two applications of herbicide annually. The Bureau of Sport Fisheries and Wildlife, Department of the Interior, is performing research under a Memorandum of Agreement with the Corps to determine the effects of various herbicides on fish and wildlife.
- Waccamaw River Maintenance, 6D. Clearing of debris from the channel in the river is performed as required.

- Murrells Inlet Project, 6E. A channel through a small tidal inlet is subject to obstruction from shoals of sand. The project will provide a 12-foot entrance channel and a 10-foot inner channel totalling 4.4 miles in length. Jetties will be constructed on both sides of the inlet, and a fishing walkway will be provided on the south jetty.

- Intracoastal Waterway, 6F. Current operations include dredging of shoaled segments of the waterway to restore the normal channel depth and removal of debris. Many of the dredged material (dredge spoil) disposal areas have been diked and more diking is planned.

- Reevaluation of Disposal Areas, 6G. Details of this project are given in Section 3.6.1, Existing Land Use.

- Little River Inlet Project, 6H. This project will provide an entrance channel 12 feet deep by 300 feet wide across the ocean sandbar and a channel 10 feet deep by 90 feet wide to the Intracoastal Waterway. Two jetties, 3200 and 3000 feet long, are planned for protecting the channel.

3.12 SUMMARY OF SENSITIVE MAN-MADE AREAS

Areas and sites in the man-made environment which potentially are sensitive to disruption from new projects include historical, archeological, cultural, and recreational areas, prime agricultural lands, high density areas, and energy consumption areas. The most significant sensitive man-made areas in the Grand Strand are summarized below.

3.12.1 Archeological Sites

The number of archeological sites in the planning area has not been determined. A few of the known sites which are particularly susceptible to loss from future construction are sites G1, G4, G14, and G25 in Georgetown County, and all sites in Horry County, except sites H14 and H15. Some of these sites were taken into consideration in planning the sewer facilities.

3.12.2 Recreational Sites

Inadequate sanitary facilities have already exposed state parks in the planning area to pollution. For example, in Huntington Beach State Park, the septic tank system is considered a pollution hazard. Although present pollution levels are not high, they could become significant with the expected increase in park usage.* Expected growth in attendance at other parks could lead to similar pollution problems.

A particularly sensitive recreational area is the Buist Game Management Area. It is privately owned and subject to development. Although the schedule of future development is not known, the WRPDC land use plans expect full development of the area by 1990.

Campsites in the planning area are also sensitive man-made areas. Many of the campsite lands are clearly holding zones in anticipation of advantageous conditions for higher use development. The supply of campsites, or distribution of campsites within the planning area, is subject to change as a result of higher density developments such as hotels and condominiums. For example, conversion is now planned in the Dunes area.

3.12.3 Heavily Used Corridors

The State Highway Department reports that roadways in the planning area are already heavily congested. Rapidly escalating land prices make the purchase of new rights of way prohibitive and, therefore, deter efforts to expand capacity. Continued population and economic growth will contribute to increased real estate costs. Particularly sensitive corridors will be Route 501, the area around Conway, the immediate vicinity of the city of Myrtle Beach, and the beachfront areas.

3.12.4 Energy Consumption and Production

Demand for electricity and fuel continues, despite the energy crisis and initial conservation efforts. Consumption of fuel, both kerosene and Number 2 fuel oil, increases approximately 11-12 percent annually. The electricity and fuel distribution systems do not appear to be susceptible to impacts from new construction projects. It also appears that the electric utility system can meet population increases because of existing excess capacity, interconnections to regional systems, and planned projects.

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* "Master Plan for Huntington Beach State Park," South Carolina Department of Parks, Recreation, and Tourism, Division of State Parks, September 1974.

3.13 SUMMARY OF PERTINENT LAWS, REGULATIONS AND ORDINANCES

This section summarizes pertinent state and local legislation and regulations concerning water pollution control, waste disposal, and planning. The State of South Carolina has legislation which establishes a Department of Health and Environmental Control (DHEC) and empowers the DHEC to abate, control, and prevent water pollution by promulgating water quality standards and issuing or denying disposal permits. The Department has issued both Classification Standards (water quality standards and discharge rules) and Guidelines for Water Disposal. Solid waste disposal is regulated by the South Carolina Industrial Waste Disposal Site Regulation and the Cellulosic Materials Disposal Guideline.

In addition, the state has enacted enabling statutes which authorize, but do not require, communities to engage in planning, zoning, and subdivision regulation. Georgetown County has enacted zoning and subdivision regulations. Horry County has no county-wide regulations but some of its communities have developed their own. Regional planning is coordinated by the Waccamaw Regional Planning and Development Council.

CHAPTER 4

ALTERNATIVE EVALUATION

This chapter presents the development of the feasible wastewater treatment alternatives which have been considered for the Grand Strand area. The development followed a systematic approach which includes the following general considerations which are discussed in detail in subsequent sections:

4.1 Background

4.2 Development and Evaluation of Subsystem Alternatives

4.3 Development and Evaluation of Alternative Wastewater Management Plans

4.4 Evaluation of Seven Additional Alternatives

This approach provides a thorough screening and evaluation of the wastewater treatment alternatives. The ultimate result is the development of a recommended proposed action plan which is the most economical and environmentally sound alternative for the Grand Strand Region.

4.1 BACKGROUND

The Grand Strand Facilities Plan was completed and submitted to the South Carolina Department of Health and Environmental Control and the U.S. EPA in June, 1974 and was revised in November, 1974. The plan presented thirteen alternatives which were evaluated on the basis of costs, environmental impact, and implementability. The U.S. EPA determined that an EIS was required. During the evaluation of the Grand Strand Facilities Plan, the following findings were made:

- The population projections used in the facilities plan were excessive. These projections were modified.

- The water quality model which was used to determine load allocations from the Grand Strand to the Waccamaw River and Intracoastal Waterway had not been field calibrated with sufficient water quality data prior to allocating loads. Additional water quality data were collected and the model was reviewed in detail by U.S. EPA. It was found that the water quality of the Waccamaw River and Intracoastal Waterway was much worse than expected and that secondary treatment as proposed in the facilities plan would result in water quality degradation.

As a result of the above findings, the Grand Strand Water and Sewer Authority was instructed to (1) reduce the size of plants and interceptors in the north and central portions of the Grand Strand; and (2) add higher levels of treatment to the proposed plants which would result in meeting water quality standards. In addition, the Grand Strand Water and Sewer Authority was to evaluate seven additional alternatives which were all modifications of the proposed action.

Since the new plant and interceptor sizes and effluent requirements were determined only for the proposed action in the north and central service areas of the Grand Strand, the presentation and evaluation of the alternatives will be in two parts. The sizing and effluent requirements used in the facilities plan will be utilized for the preliminary evaluation of all identified alternatives. The final evaluation of the seven modifications of the proposed action will use the new population projections and water quality requirements. The use of the old population projections and effluent requirements will not alter the outcome in that these factors are applied equally to all alternatives.

4.2 DEVELOPMENT AND EVALUATION OF SUBSYSTEM ALTERNATIVES

This section identifies and evaluates the subsystems critical to the development of the wastewater management alternatives. The general subsystem categories include the following:

4.2.1 Flow and Waste Reduction Measures
4.2.2 Transmission Systems
4.2.3 Existing Wastewater Treatment Plant
4.2.4 Location Alternatives
4.2.5 Effluent Disposal
4.2.6 Treatment Processes
4.2.7 Sludge Disposal

4.2.1 Flow and Waste Reduction Measures

A description of non-structural control measures and techniques which may potentially reduce flow and waste from the study area are explained below.

4.2.1.1 Negative or No Growth Policy

The Waccamaw Regional Planning and Development Council land use plan for the Grand Strand area indicates further residential and commercial development in most of the area north of Pawley's Island. The southern portion of the Grand Strand remains agricultural and forest covered. Chapter 3 provides the detailed characterization of the existing and future population of land use activities.

A negative or no growth policy would have to be applied not only to the permanent population but also to the tourist population in order to be effective. The flow of wastewater during the tourist season is 3 to 6 times greater than the normal off season period. Treatment facilities must be designed for the peak tourist flows. Since the Grand Strand area has already made a substantial investment in tourist facilities (hotels, national golf courses, etc.) and the area has one of the finest beaches along the Atlantic coast and is reasonably close to the heavily populated northeast, a no growth policy is not feasible for the Grand Strand.

4.2.1.2 Land Use and Development Controls and Management Practices

The implementation of land use development controls and management practices are discussed in Chapter 3 of this report. These controls directly affect the population contributions as determined for the Grand Strand Region and their relationship to land use and economic development. The impact of these controls could greatly affect the wastewater flows from the Grand Strand Region as indicated by the large increase in populations served throughout the 20 year planning period. However, due to the growth pressures which currently exist in this area, it is anticipated that modifications to the population projections as developed are minimal.

4.2.1.3 Non-Point Source Controls

Due to the limited agricultural practice in this area, agricultural runoff does not present a significant water quality problem. Likewise, water quality problems resulting from erosion or sedimentation are minimal due to the sandy soil characteristics and relatively flat terrain. Urban runoff, however, is a definite water quality problem in the Grand Strand Region. Beach quality along the Grand Strand has been lowered due to urban runoff.

A program could be initiated to reduce the resulting pollution from urban runoff. The program could include structural and/or non-structural alternatives. This problem and its relationship to non-point source control alternatives will be assessed in the 208 plan for this area.

4.2.1.4 Industrial Reuse and Recycling

The current industrial use of water only amounts to about 0.44 mgd of the total 16.7 mgd discharged from the Grand Strand Area. Since the relative amount of water used by industry is small and the characteristics are similar to domestic wastes, industrial reuse would have little impact on flow or load reduction.

4.2.1.5 Improved Operation and Maintenance Techniques

The Master Plan of Wastewater Facilities for the Grand Strand Region (201 Plan), stated that many existing systems fail to utilize design capabilities fully due to the lack of qualified and experienced wastewater system operating and maintenance personnel.

An upgrading of operating and maintenance personnel will increase plant performance and removal efficiencies, decrease the potential for mechanical breakdowns, and help to insure the use of all facilities to their design capabilities. This upgrading can potentially provide a significant reduction of pollutant discharges from the wastewater treatment facilities, although the degree of reduction cannot be accurately predicted.

4.2.1.6 Water and Sewer Rate Structure Alterations

Increases in water and sewer rates have not worked consistently in the past as a means for reducing water consumption. A major reason why a rate structure increase would not be effective in reducing water use in the Grand Strand area is the fact that this is a resort area, and as such, the increased costs would be passed on to the tourist, with limited probable effects on water consumption.

4.2.1.7 Educational Programs for Decreased Water Use and Wastewater Generation

Educational programs have not worked in water abundant areas, and as was discussed in the groundwater section of Chapter 2, the Grand Strand appears to have sufficient groundwater supplies. It is very difficult to provide an education program which would reduce the water consumption of the tourists who spend only short periods of time in the area. In addition, it is probable that local residents would resist public water reduction programs as having adverse effect on the attractiveness of the region to tourist trade.

4.2.1.8 Legislation of Flow and Waste Reduction Devices

Legislation of flow and waste reduction devices might be a feasible non-structural alternative. Examples of legislation of flow and waste reduction devices include:

- Requiring the installation of water conserving devices in new construction
- Prohibiting local sales of excessive water-using appliances
- Controlling any new or expanding development of industry which uses excessive amounts of water
- Providing tax incentives for buying water saving devices and/or tax disincentives for use or installation of excessive water using devices.

4.2.2 Transmission Systems

The transmission systems to be designed are to service only those areas of the Grand Strand Region anticipated to develop during the 1977-1997 planning period. The limited number of existing collection systems are to remain.

Alignment alternatives cannot be presented until specific wastewater treatment plant locations are determined. The design capacities and the phasing of the projects are specific for each separate alternative considered. Factors considered in determining the extent of the collection systems are listed below:

- Population projects and disaggregation
- Land use
- Service will not be extended to isolated areas or parks which are judged to be more efficiently served by package plants or septic tanks throughout the planning period
- The most direct routing to regional treatment plants
- The most compatible routing with existing and proposed collection systems
- Physical and environmental features.

Flow equalization has been considered as an alternative in the design of wastewater collection systems because of the great variability in the sewage flows. This technique utilizes a storage tank to collect peak flows which are discharged into the system for treatment during low flow periods, thereby reducing the size of transmission and treatment facilities.

Infiltration/inflow was determined to be non-excessive as reported in the October, 1974, Facilities Plan. Therefore, the collection and treatment facilities were designed to include the infiltration/inflow from the Grand Strand Region.

Three types of wastewater collection systems have been evaluated. These are: (1) gravity; (2) gravity-lift; and (3) manifold force main. A gravity collection system has the advantage of not requiring any energy for operating. There are no pumps to malfunction and power failures will not result in the bypass of raw sewage. However, the terrain in the Grand Strand is relatively flat which would require deep sewers to provide the necessary slope. The high water table and sandy nature of the soils create problems in construction of deep sewers. In addition, gravity sewers would have to be sized to carry the peak hydraulic load which occurs during the tourist season. During non-peak flow periods, gravity sewers could result in septicity problems and the settling of solids in the sewers.

Gravity sewers in combination with lift station and force mains and manifold force main systems can be utilized to overcome the problems of a collection system composed exclusively of gravity sewers.

A cost analysis was made between using a manifold force main system versus a gravity-lift system. The selected route for comparison was 44,100 ft. along U.S. Highway 17 which is the most feasible and advantageous place for a gravity-lift transmission line. The cost came out as shown below.

Type of Transmission System	Present Worth* Capital and O & M
Manifold Force Main	$3,089,600
Gravity-Lift Main	3,618,712

*Assuming interest at 7 percent over a 20 year period

The utilization of the flow equalization tanks is compatible with the force main system and has been considered as part of the collection systems. The system provides a more uniform flow and reduces the peak flow ratio thereby resulting in reduced transmission line sizes and costs.

Due to the advantage of gravity sewers over a force main system, (low energy and maintenance requirements, less opportunity for sewage bypassing) gravity sewers will be utilized to the extent possible in the Step 2 design of the wastewater facilities. The result will be the utilization of all three methods of wastewater collection depending upon the particular conditions in any given area.

4.2.3 Existing Wastewater Treatment Plants

The Grand Strand Region is a 400 square mile area served by inoperative on-site disposal systems in many developed areas in addition to 58 private or semi-public, 10 public, and 3 industrial wastewater treatment facilities. These facilities vary in their degree of treatment from excellent to poor, with a substantial number producing a poor quality effluent.

Complaints are common concerning poor water quality and potential health hazards. The livelihood of the Grand Strand is dependent upon high quality water along the ocean front. With such a large number of small package sewage treatment plants, water quality problems can be expected. It is a primary objective of the facilities planning effort to eliminate as many of these small package plants as possible and replace them with regional treatment facilities which will assure high quality fresh and salt water areas.

Each of the private, semi-public, and public wastewater facilities were evaluated to determine their condition and potential for serving as regional facilities, temporary interim facilities, or to remain in operation for the duration of the planning period.

The results of this evaluation by the facilities planning team found the following conclusions:

- Myrtle Beach-1 (MB-1), North Myrtle Beach-1 (NMB-1), North Myrtle Beach-2 (NMB-2), Myrtle Beach Air Force Base (AF-1), and Litchfield Beach (LB-1) were the only plants capable of serving as either interim or permanent regional plants. This determination was based on condition, size, location, and ease of modifying to serve as a regional plant.
- Debordieu Colony Plant is a well operated tertiary plant serving the isolated development of Debordieu Colony at the southern end of the Waccamaw Neck. This plant can serve this community for the duration of the planning period.
- The Brookgreen Gardens Wastewater Plants serves this isolated natural preserve. It is infeasible to extend regional facilities to this preserve.

- The Watergate Subdivision, Creekside Mobile Home Park, Baker and Stevens, Baytree Condominiums, South Carolina Welcome Center, Forestbrook Subdivision and, Cypress Creek are somewhat isolated and each served with individual well operated tertiary treatment facilities capable of continued use until latter phases of regionalization.

- The Grove Trailer Park and Hope Willard Washerette wastewater plants should be upgraded to tertiary treatment using salvaged plants from other portions of the region until later phases of regionalization.

- All other public, semi-public, and private plants should be phased out as soon as new regional facilities are available.

- The industrial wastewater plants serving the Wolverine Brass Works and American Gear and Pinion should serve as pre-treatment facilities prior to discharge to new regional facilities. Toyota Motors is remote so that its plant should be upgraded to continue discharge to the Intracoastal Waterway.

4.2.4 Location Alternatives

Because of the very large area encompassed by the facilities plan, one, two, three, and four regional wastewater treatment plant concepts are proposed as alternatives. Each of the regional plant alternatives combines various combinations of existing useable wastewater treatment facilities.

Since the possible locations of sewage treatment plants are almost unlimited, preliminary screening and final selection of optimum treatment plant locations were made in the Facilities plan by the following factors:

- Geographical center of population and service area for year 1997. Service area centroids were determined in the following manner:

    - A total planning area map was overlayed with a 2-mile square grid system.

    - The 100-year flood prone area and service area boundaries were placed on the grid.

- Flood-free and flood-prone areas were weighted on the basis of the degree of service that will be required during the 20-year planning period. This necessitated a review of existing and proposed land use patterns and population projections.

- Two perpendicular (X and Y) axes were established on the perimeter of the planning area map. The weighted area in each 2-mile square segment was multiplied by the distance from the center of the segment to the X and Y axes established.

- The coordinate of the centroid of each service area was calculated by dividing the summation of each unit area times distance by the total area of the service area.

Population centroids were determined in a manner similar to the service area centroids. The main differences were:

- The planning zones of the Waccamaw Regional Planning Council were used instead of the 2-mile square segments.

- The population center of each planning zone was determined for 1997 using the Waccamaw Regional Planning and Development Council projections, the land use plan, and the flood prone map.

- The coordinates of each population centroid were calculated by dividing the summation of populations times distance by the total population of the service area.

- Land suitablility

- Land availability

- Land elevation

- Land use

- Land configuration
- Land accessibility
- Social and environmental factors.

4.2.4.1 Existing Plant Location Evaluations

The existing locations for Litchfield Beach (LB-1), Myrtle Beach (MB-1), North Myrtle Beach (NMB-1), and a second plant in North Myrtle Beach (NMB-2) are shown on Figure 4-1, together with the locations for the three proposed regional plants, A, C, and G.

Plant LB-1 is close to the location shown in the three and four regional plant configurations for Plant "C". This 0.5 mgd package plant could be incorporated with the new facility.

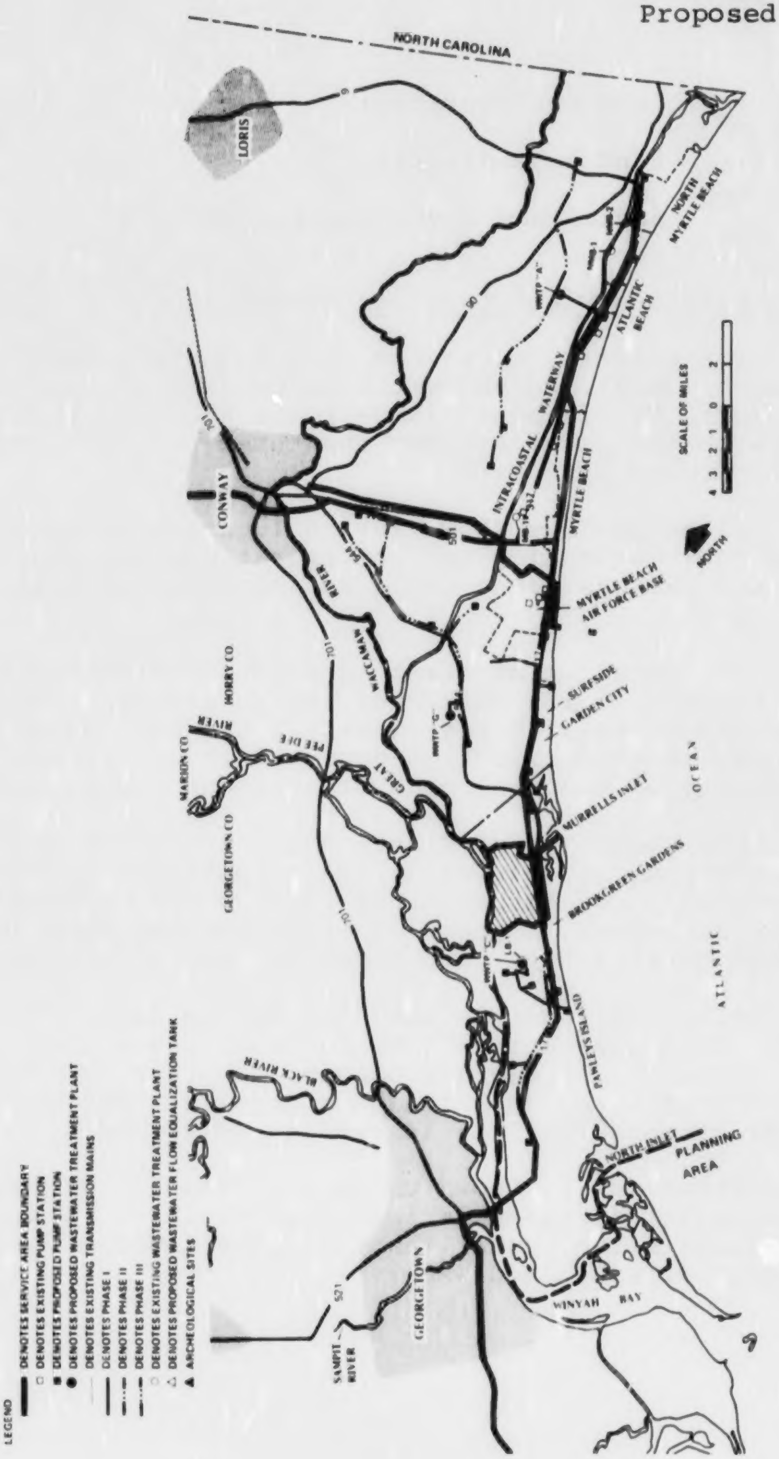
The location of Plant MB-1 is acceptable for the planning period, if its continued use is assumed. The City of Myrtle Beach has a 40-year lease on the land which contains this 50-acre aerated oxidation pond and it is located in the close vicinity of the centroids of area and population.

The locations of Plants NMB-1 and NMB-2 are acceptable for the planning period if their continued use is assumed. Further expansion of either plant site is not recommended because both sites are in areas of environmental concern. Invertebrated fossils have been found in this vicinity.

Plant AF-1 serves only the Myrtle Beach Air Force Base. The only apparent options for this plant are to either continue serving only the air base or to phase out the facility in favor of a regional treatment system. Thus, the continued use of this facility is considered optional.

There are no known unique historical, archaeological or environmental features in the close vicinity of any of the existing plant sites, other than the invertebrate fossils in the vicinity of NMB-1 and NMB-2.

FIGURE 4-1
Proposed Action



LEGEND
DENOTES SERVICE AREA BOUNDARY
□ DENOTES EXISTING PUMP STATION
■ DENOTES PROPOSED PUMP STATION
● DENOTES PROPOSED WASTEWATER TREATMENT PLANT
DENOTES EXISTING TRANSMISSION MAINS
DENOTES PHASE I
DENOTES PHASE II
DENOTES PHASE III
○ DENOTES EXISTING WASTEWATER TREATMENT PLANT
△ DENOTES PROPOSED WASTEWATER FLOW EQUALIZATION TANK
▲ ARCHEOLOGICAL SITES
NORTH CAROLINA
LORIS
9
90
701
CONWAY
501
544
INTRACOASTAL
WATERWAY
MYRTLE BEACH
ATLANTIC BEACH
NORTH MYRTLE BEACH
SCALE OF MILES
4 3 2 1 0 2
NORTH
MYRTLE BEACH AIR FORCE BASE
RIVER
WACCAMAW
HORRY CO
MARION CO
RIVER
PEE DEE
GREAT
SURFSIDE
GARDEN CITY
MURRELLS INLET
OCEAN
GEORGETOWN CO
BROOKGREEN GARDENS
ATLANTIC
PAWLEYS ISLAND
BLACK RIVER
NORTH INLET
PLANNING AREA
WINYAH BAY
521
GEORGETOWN
SAMPIT RIVER

4.2.4.2 Future Plant Locations Evaluation

This section evaluates various regional treatment plant locations. There are four major configurations including: one plant, two plants, three plants, and four plant configurations.

- One Plant Location - The proposed plant location (Plant E) is selected for the following reasons:
  - Its location in the light industrial zone is more compatible than in the commercial and residential land use area on the east side of the Intracoastal Waterway.
  - The existing Myrtle Beach oxidation pond can continue to accommodate its service area until the proposed plant is operational, thus facilitating a convenient changeover.
  - Its elevation is above the flood prone area.
  - Its location is close to the centroid of population and service area and yet is adequately separated from the high population density along the beaches.
  - There are no unique historical, archaeological or environmental features at the proposed plant site. It is located on the perimeter of the Buist Tract on a site which is being considered for preservation under the Heritage Trust Program, but does not include significant pine timber or cypress bays cited for preservation.
  - The proposed site has ready access to U.S. Highway 501.
  - The site is outside the limits of the proposed routing of the Coastal Corridor Highway and the Florence-Grand Strand Corridor Highway.
  - As the site is on open land at this time, there are no apparent restraints to acquiring an optimum site configuration for the plant facilities.

- Two Plant Locations - The proposed location for Plant "A" is selected for the following reasons:

  - It is close to the centroid of the service area and close to the Intracoastal Waterway for discharge.

  - It has been approved as a compatible site by the developers and planners of the Buist Tract. Thus, land suitability and availability are well established.

  - Its elevation is above the flood prone area.

  - There are no unique historical, archaeological or environmental features in the vicinity of the site except for the Heritage Trust Program designation of the Buist Tract.

  - The proposed site has ready access to the proposed extension of County Road 137 through the Buist Tract.

  - The site is outside the limits of the proposed routing of the Coastal Corridor Highway and the Florence-Grand Strand Highway.

  - The site is on open land at this time, and there are no apparent restraints to acquiring an optimum site configuration for the plant facilities.

- The proposed location for Plant "B" is selected for the following reasons:

  - It is close to both the centroid of the service area and population, and close to the Waccamaw River for discharge.

  - Its elevation is above the flood prone area.

  - The plant is compatible with the low density residential land use of its surrounding area.

- There are no unique historical, archaeological or environmental features in the vicinity of the site.

- The proposed site has ready access to State Road 544.

- The site is outside the limits of the proposed routing of the Coastal Corridor Highway.

- The site is on open land at this time, and there are no apparent restraints to acquiring an optimum site configuration for the plant facilities.

- Three Plant Locations - The reasons for selecting the proposed location of Plant "A" were previously presented in the two plant locations Section.

  The proposed location for Plant "G" is selected for the following reasons:

  - It is centrally located between the centroids of population and service area.

  - Its elevation is above the flood prone area.

  - The plant is compatible with the surrounding low density residential land use.

  - There are no unique historical, archaeological or environmental features in the close vicinity of the site.

  - The proposed site has ready access to County Road 375.

  - The site is outside the limits of the proposed routing of the Coastal Corridor Highway.

  - The site is on open land at this time, and there are no apparent restraints to acquiring land for plant facilities.

- The proposed location for Plant "C" is selected for the following reasons:
  - It is centrally located between the centroids of population and service area.
  - Plant LB-1 can be expanded into the regional facility.
  - Although the site is located in a flood prone area, it can be flood proofed with little upstream impact.
  - There are no unique historical, archaeological or environmental features in the close vicinity of the site.
  - The proposed site has ready access to U.S. Highway 17.
  - There is sufficient land available for expansion of Plant LB-1.
- Four Plant Locations - The reasons for selecting the proposed locations for Plant "B" and "C" were presented in previous sections.

  As the proposed location for Plant "D" is in the close vicinity of Plant "E", described in the one-plant configuration, the location justification is also applicable to Plant "D".

  The proposed plant location for the Plant "F" is selected for the following reasons:
  - It is centrally located between the centroid of population and service area.
  - Its elevation is above the flood prone area.
  - The plant is compatible with the low density residential land use of the surrounding area.
  - There are no unique historical, archaeological or environmental features in the close vicinity of the site.

- The proposed site has ready access to State Road 90.
- The site is outside the limits of the proposed routing of the Coastal Corridor Highway.
- The site is on open land at this time, and there are no apparent restraints to acquiring an optimum site for the plant facilities.

4.2.5 Effluent Disposal

The potential alternatives for disposal and/or reuse of the effluent in the Grand Strand Region area are as follows:

- Intracoastal Waterway and Waccamaw River Outfalls
- Deep Well Injection
- Ocean Outfalls
- Land Spreading (irrigation) with Distribution System
- Percolation ponds
- Commercial and Industrial uses
- Aquifer recharge.

The basis on which the above were evaluated to be feasible alternatives are water quality requirements, soil characteristics, availability of ground and surface water supplies, geology, and oceanographic features.

4.2.5.1 Intracoastal Waterway and Waccamaw River Outfalls - Water Quality Modeling Studies

A computer model was utilized to determine the required effluent quality for alternate treatment plant configurations during the period 1977-1997. The model was originally prepared for the South Carolina Department of Health and Environmental Control by Dr. Billy Edge, Associate Professor of Civil Engineering at Clemson University. The version that was used was modified in order to account for separate carbonaceous and nitrogenous oxygen demand, variable lag time before onset of the nitrogenous oxygen demand, and variable reaeration coefficient according to the O'Connor-Dobbins equation.

Alternative plant configurations were analyzed to determine impact of the plant effluent upon receiving water dissolved oxygen concentration under seven-day, ten-year low flow conditions. For each five year design period between 1977 and 1997 it was assumed that such critical conditions would occur simultaneously with waste loadings at the time of the peak tourist season (May-June). These critical conditions are also likely to occur during November-December, when waste loadings are low. In addition, the dissolved oxygen concentration during the last day of the critical period was compared with the stream standard to determine the capability of any alternate plant to meet water quality objectives. This combination of extreme circumstances has a very low probability of occurrence.

The approach followed in the development of feasible alternative plans was to first determine typical effluent quality characteristics for five levels of wastewater treatment, as shown in Table 4-1.

These effluent quality characteristics are based upon an assumed influent of BOD_5 of 200 mg/l and an influent TKN of 25 mg/l, as determined from analyses of samples collected for the 201 Facilities Plan at three major wastewater treatment facilities in the Grand Strand area during September, 1974. Five year design periods between 1977 and 1997 were utilized, and wastewater flows to thirteen separate plant and effluent disposal configurations were calculated for each design period. These configurations included one, two, three and four new treatment facilities plus combinations of each of these with some or all of the existing treatment plants. In addition, alternate effluent disposal points were studied for several plant configurations. Existing facilities were assumed to be operating at design capacity during the critical low flow period, with effluent quality estimated by the consulting engineers following evaluation of these facilities.

Computer results indicated that secondary treatment would be adequate for any waste discharges to the Waccamaw River below the confluence point with the Intracoastal Waterway. It was also determined that secondary treatment is adequate for discharge of the effluent from a single regional treatment facility, if the effluent is discharged to the Waccamaw River below the confluence with the Pee Dee River.

Table 4-1

Effluent Quality for Selected Wastewater Treatment Processes
Grand Strand 201 Facilities Plan

Process No.	Process Description	BOD_5 (mg/l)			TKN (mg/l)			UBOD (mg/l)			Lag Time (days)	Effluent D.O. (mg/l)
		Min.	Max.	Typical	Min.	Max.	Typical	Min.	Max.	Typical		
1	Secondary Treatment	15	25	20	18	23	22	107	133	145	7	4
2	Secondary plus partial nitrification	15	25	20	16	20	18	97	131	114	4	4
3	Secondary plus complete nitrification	15	20	18	5	10	7	46	82	60	0	5
4	Tertiary (Process 3 plus filtration)	5	15	10	5	10	6	31	69	48	0	5
5	Completed Advanced Waste Treatment	3	7	5	1	3	2.5	9	24	19	0	5

1 Based upon assumed influent BOD_5 = 200 mg/l, TKN = 25 mg/l.
2 UBOD - 1.5 BOD_5 + 4.57 TKN
3 Typical values used for computer analyses.

As discussed at the beginning of this Chapter, subsequent water quality model analyses indicated more stringent effluent requirements for discharge to the Intracoastal Waterway. However, for the preliminary analysis of the thirteen alternatives, the same data were used as were developed and used in the Facilities Plan. Final evaluation of alternatives will use the new population projection and water quality requirements.

4.2.5.2 Deep-Well Injection

For the disposal of wastewater by deep-well injection to be successful in the Grand Strand-Conway area, the following is required:

- The receiving aquifer must not contain potable water.
- Potable water in adjacent aquifers must be protected from contamination.
- The receiving aquifer must be permeable enough to accept the injected wastes at a safe injection pressure.

The Tuscaloosa is the only aquifer in the area that does not contain water suitable for potable use. The water has a high chloride content, especially in the northern part of the Grand Strand. The transmissivity of the aquifer in this area, however, is quite low, indicating a low injection capacity. Because the injection capacity of a well tapping the Tuscaloosa would probably be low, and because of the proximity of the Tuscaloosa to the principal aquifer in the area, the Pee Dee - Black Creek Aquifer, injection wells are not recommended for wastewater effluent disposal in the Grand Strand.

4.2.5.3 Ocean Outfalls

Investigations were undertaken during the course of the Facilities Plan to locate any existing ocean outfalls in either North or South Carolina; however, none were found. Recently a permit was granted to Carolina Power and Light Company for construction of a 2,000-foot outfall near South

Port, North Carolina, to discharge cooling water effluent. At this location, considerable mixing and flushing occurs due to adjacent flows from the Cape Fear River.

The coastal shelf adjacent to the Grand Strand area is relatively shallow, reaching a depth of about 300 feet at a distance of 60 miles from shore, at the edge of the Gulf Stream. However, the coastal shelf is not a smooth plain; it is broken by many irregularities, most of which have less than 30 feet of relief. These irregularities form a series of shelves which help dissipate the energy of large ocean waves formed by regional current. Available information suggests that considerable tendency exists for flow discharged within about a mile or two offshore to be carried back to the beaches by the prevailing current.

The Environmental Protection Agency has released an environmental impact statement on ocean outfalls and deep well injection in South Florida, which concluded that ocean outfalls in that area were acceptable due primarily to two conditions: the existing very poor water quality of the inland waterway system due to wastewater discharges, urban runoff and the resulting high nutrient loadings, and the close proximity of the Gulf Stream to the shore, providing considerable dispersion action.

The Gulf Stream is not close enough to the Grand Strand coastline to provide the desirable dispersion. Furthermore, the entire Grand Strand tourism is tied to its excellent beaches and clean ocean water. It is very desirable to preserve these qualities.

The densely populated land uses along the Atlantic beaches dictate a minimum setback of a mile or more for wastewater treatment plants. The cost of constructing large outfalls through the densely populated beach areas plus a multi-mile ocean outfall would be high.

Although the Facilities Plan did not present detailed cost estimates of ocean outfalls, there is no question that an ocean outfall would be much more costly than other alternatives.

Ocean outfalls are not recommended for effluent disposal.

4.2.5.4 Land Application

In order to investigate the feasibility and economics of land application of effluent, studies were conducted to determine soil characteristics in the study area, as well as anticipated effluent characteristics, percolation rates and possible irrigation sites.

Twenty-three auger holes were constructed to evaluate soil characteristics, of which ten were utilized for percolation tests. These were all six-inch diameter holes, with depths up to 8 feet. Since it is anticipated that land spreading of effluent might be accomplished on many of the 27 existing golf courses and on other courses planned for the future, many of the auger holes were constructed on or near golf courses. Four holes were constructed in the vicinity of the north treatment plant site and two holes were constructed near the south treatment plant site. The remaining holes were located in order to permit evaluation of soil characteristics of intermediate areas to supplement limited existing soil data.

The results of these field investigations indicate that land spreading of effluent is generally feasible in the northern area of the Grand Strand. Auger holes in this area encountered primarily medium sand at almost all sites to a depth of up to 8 feet. The water table was generally encountered 3 to 8 feet below ground level, although depending upon the season, it is often at or near ground surface.

Prior to implementation of spray irrigation plans at specific sites, it would be advisable to construct additional auger holes, perform percolation tests, and obtain a limited number of split spoon samples to the base of surface deposits. High infiltration rates might be possible on many sites in this northern area. However, it is desirable to locate irrigation facilities wherever possible in areas where the water table is not close to land surface.

The four auger holes constructed in the immediate vicinity of the proposed north wastewater treatment plant site all encountered the water table at a depth of 3-4 feet. The holes were constructed close to their lowest elevation during the year. Consequently, any land disposal of effluent in the immediate vicinity of the north treatment plant site would encounter high water table problems.

At the two auger holes constructed near the south wastewater treatment plant site, the water table is at a depth of about 7 feet, however, the soils are primarily clay and sandy soil. Information supplied by the U.S. Department of Agriculture Soil Conservation Service suggests that pockets of more snady soil are found in this area although, in general, clay is present throughout the area. Infiltration rates would be considerably lower than those expected in the northern part of the study area.

Measured percolation rates for the 10 test holes at which tests were performed indicated rates of about one minute/inch for sandy soil, up to 10 minutes/inch for sandy soils with some clay. Where solid clay was encountered, the percolation rate was about 80 minutes/inch.

In summary, land disposal of effluent by spray irrigation is more feasible in the northern areas of the Grand Strand than the central or southern areas. However, due to the seasonally high water table in most soil types, land application could not be utilized on a year round basis. In order to dispose of effluent on land, an alternative effluent disposal system would have to be used when the water table is high.

4.2.5.5 Percolation Ponds

The percolation rate studies mentioned in the previous section are directly applicable to the consideration of percolation ponds. The potential for this technique is better in the northern part of the planning area than in the south.

Each site must be investigated in considerable detail as part of the detailed design. Soils and seasonally high water tables are the major constraints for the use of percolation ponds. Percolation ponds generally will not be feasible for effluent disposal in the Grand Strand.

4.2.5.6 Commercial and Industrial Uses

Treated wastewater can be used for low energy heating and air conditioning systems. However, the major benefit is derived in areas having limited water supplies. As was presented in Chapter 2, the Grand Strand is not a water short area and, therefore, this alternative will not be considered further.

4.2.5.7 Aquifer Recharge

Aquifer recharge has been used to augment ground water supplies and wastewater has been injected into potable aquifer to reverse salt water intrusion. Aquifer recharge generally requires advanced waste treatment beyond that which is normally required for disposal to surface water. Since the Grand Strand appears to have adequate groundwater with no apparent salt water intrusion problems, this alternative does not seem warranted of additional evaluation.

4.2.5.8 Summary of Effluent Disposal Systems

The previous evaluations of various effluent disposal alternatives indicates that disposal of effluent to either the Intracoastal Waterway or the Waccamaw River is the preferred alternative. Although land application of effluent is generally limited by soil types and a seasonally high water table, this alternative might be feasible in the northern portion of the planning area.

For the evaluation of treatment processes and preliminary alternative plans, it is assumed that all wastewater will be discharged to either the Waccamaw River or Intracoastal Waterway.

4.2.6 Treatment Processes

Treatment processes are discussed and evaluated in this section. The type of process used is determined largely by the requirements for discharge to either the Waccamaw River or the Intracoastal Waterway. Since the water quality model indicated higher levels of treatment required as the population increased, plant processes which allow these modifications to be made with relative ease are preferred.

4.2.6.1 Septic Tanks

The soil of the Grand Strand has been rated extremely severe to moderate for the use of septic tanks. The coastal areas had a rating of severe and the wetlands had a rating of very severe. In low density use, septic tanks will not create significant problems. However, in densely populated areas, septic tanks will not provide adequate treatment.

4.2.6.2 Plant Processes

- Pretreatment. Standard pretreatment facilities including bar screens, grit removal, and comminutors are to be used for any treatment scheme to be employed.
- Primary Treatment. Depending upon the specific secondary treatment alternative chosen, a primary clarifier may or may not be required. However, since a complete mix activated sludge system has been determined to be the best alternative, as will be discussed in the following section, primary clarifiers have been selected for primary treatment.
- Secondary Treatment. The trickling filter was not considered because it is incapable of meeting the effluent requirements for the receiving streams.

The activated sludge system, complete mix, was selected above other activated sludge systems and physical-chemical systems because of the ease with which a complete mix system can be expanded to incorporate nitrification. Capital costs for a physical-chemical system are greater than a biological treatment system because the biological system can incorporate more of the existing facilities into its design. In addition, chemical and energy use is much higher in a physical-chemical plant than a biological plant.

- Advanced Waste Treatment. The water quality model indicates that nitrification will be required to meet dissolved oxygen criteria. In addition, filtration will be required for some plant discharges to the Intracoastal Waterway.
- Disinfection. Chlorination was chosen over ozonation because of lower capital and operating costs.

4.2.7 Sludge Disposal

Essentially, three basic methods are available for sludge disposal: (1) incineration; (2) landfill; and (3) land application. The Grand Strand provides a unique opportunity to dispose of sludge by land application. About $250,000 worth of Milorganite is purchased annually by the numerous golf courses of the Grand Strand. Since Milorganite is fortified digested sludge, a ready market exists in the Grand Strand for disposal of sludge from its own wastewater facilities. It would appear to be most unreasonable to dispose of the sludges produced locally by either incineration or landfilling, while at the same time sludge is purchased from Milwaukee.

Therefore, it is the intent to use aerobic digestion followed by sludge drying beds to treat sludge. Initially, the dried sludge will be offered to local golf courses. Research is planned thereafter to develop the sludge material into a product similar to Milorganite.

4.3 DEVELOPMENT AND EVALUATION OF ALTERNATIVE WASTEWATER MANAGEMENT PLANS

This section identifies and evaluates the preliminary alternative plans developed in the previous section. The evaluation includes cost comparisons, environmental impacts, and other critical non-cost considerations. The subsection categories are as follows:

- 4.3.1 Identification of Alternative Plans
- 4.3.2 Level of Treatment and Costs for Each Alternative
- 4.3.3 Transmission System Alternatives Cost
- 4.3.4 Cost Summary of the Alternatives
- 4.3.5 Comparison of Alternatives

4.3.1 Identification of Alternative Plans

A total of thirteen basic potential regional wastewater treatment plant configurations have been identified. They are summarized hereafter. Existing plants MB-1, NMB-1, NMB-2 and AF-1 all discharge to the Intracoastal Waterway. Existing plant LB-1 discharges to the Waccamaw River. New regional plants A, D, E, F and G discharge to the Intracoastal Waterway and Plants B and C discharge to the Waccamaw River unless otherwise stated.

- Alternatives for One Regional Treatment Plant
    - Plant E and no existing plants.
    - Plant E and all existing plants.
    - Plant E and all existing plants - E discharge to Waccamaw River.
    - Plant E and existing Plant MB-1.
- Alternatives for Two Regional Treatment Plants
    - Plant A and existing Plant MB-1 plus Plant B.
    - Plant A and existing Plants MB-1, NMB-1 and NMB-2, plus Plant B and existing Plants AF-1 and LB-1.
    - Plants A and B and no existing plants.
- Alternatives for Three Regional Treatment Plants
    - Plants A, C and G with no existing plants.
    - Plant A with existing Plants MB-1, NMB-1 and NMB-2, plus Plant C with existing Plant LB-1, plus Plant G with existing Plant AF-1.
    - Plant A with existing Plant MB-1, plus Plant C, plus Plant G.
- Alternatives for Four Regional Treatment Plants
    - Plants C, D, F and G.
    - Plant D and existing Plant MB-1, plus Plants C, F and G.
    - Plant C and existing Plant MB-1, Plant F and existing Plants NMB-1 and NMB-2, plus Plant G and existing Plant AF-1.

4.3.2 Level of Treatment and Costs for Each Alternative

The water quality standards for the planning area were previously established in Chapter 2. These standards plus the discharge points and peak seasonal flows for 1977, 1982, 1987, 1992, and 1997 were analyzed by the S.C.D.H.E.C. Water Quality Model of the Intracoastal Waterway and the Waccamaw River to determine the type of treatment required at each plant for each viable alternative.

The various treatment levels below are designed to meet the water quality requirements for the various plant configurations for the 20 year planning period. They are summarized along with their typical effluent characteristics in Table 4-2. These values were used for the computer analysis.

Table 4-2

Typical Effluent Characteristics[1]

Process Description	BOD_5	TKN (mg/l)	$UBOD^2$ (mg/l)	DO (mg/l)
Secondary Treatment	20	22	145	4
Secondary plus partial nitrification	20	18	114	4
Secondary plus complete nitrification	18	7	60	5
Tertiary (Process plus filtration)	10	6	48	5
Complete Advanced Waste Treatment	5	2.5	19	5

1 Based upon assumed influent BOD_5 = 200 mg/l, TKN - 25 mg/l.
2 UBOD = 1.5 BOD_5 + 4.57 TKN.

Peak seasonal flows, required treatment, capital costs, and operating and maintenance costs per 1,000 gallons are presented in Tables 4-3 through 4-6 for all alternatives. The operating and maintenance costs shown in the tables were adjusted to reflect the variations in permanent and peak seasonal flow. Thus, peak seasonal flow times 365 days times the unit costs shown will equal the annual operation and maintenance costs for a given year.

Table 4-3

Wastewater Treatment Plant Requirements - One Plant Alternative Grand Strand 201 Facilities Plan

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 1 Plant E and No Existing Plants					
1977	E	25.2	S + CN + F	16.5	15.0
1982	E	30.0	S + CN + F	4.1	14.2
1987	E	36.6	AWT	20.0	24.0
1992	E	44.2	AWT	8.8	23.0
1997	E	51.4	AWT	8.8	22.0
TOTAL CAPITAL COST				58.20	
Alternative 2 Plant E and Existing Plants MB-1, NMB-1, NMB-2, LB-1, AF-1					
1977	E	12.75	S + CN	7.0	15.0
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1982	E	17.55	S + CN + F	5.5	16.2
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1987	E	24.15	AWT	15.3	26.5
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0

Table 4-3 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 2 (continued)					
1992	E	35.2	AWT	12.5	24.0
	MB-1[2]	9.0	S		14.0
1997	E	42.4	AWT	8.8	23.0
	MB-1[2]	9.0	S		14.0
TOTAL CAPITAL COST				49.10	
Alternative 3 Plant E and Existing Plants MB-1, NMB-1, NMB-2, LB-1, AF-1 Plant E Discharge to Waccamaw River					
1977	E	12.75	S	5.5	11.0
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1982	E	17.55	S	2.75	10.0
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1987	E	24.15	S	3.6	9.2
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1992	E	35.2	S	5.1	8.4
	MB-1[2]	9.0	S		14.0
1997	E	42.4	S	3.6	8.0
	MB-1[2]	9.0	S		14.0
TOTAL CAPITAL COST				20.55	

Table 4-3 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 4 Plant E and Existing Plant MB-1					
1977	E	16.2	S + CN + F	10.2	17.0
	MB-1	9.0	S		14.0
1982	E	21.0	S + CN + F	4.0	15.5
	MB-1	9.0	S		14.0
1987	E	27.6	AWT	17.4	25.5
	MB-1	9.0	S		14.0
1992	E	35.2	AWT	8.8	24.5
	MB-1[2]	9.0	S		14.0
1997	E	42.4	AWT	8.8	23.0
	MB-1[2]	9.0	S		14.0
TOTAL CAPITAL COST				49.20	

1 Treatment Code Letters: S - Secondary, CN - Complete Nitrification, PN - Partial Nitrification, F - Filtration.

2 All Existing Plants But MB-1 Phase Out.

3 O & M: The annual average operation and maintenance costs of the treatment plant.

Table 4-4

Wastewater Treatment Plant Requirements - Two Plant Alternative Grand Strand 201 Facilities Plan

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 5 Two Plants and Existing Plant MB-1					
1977	A	8.4	S	4.1	14.5
	B	7.8	S	3.8	12.2
	MB-1	9.0	S		14.0
1982	A	11.2	S + CN	3.2	15.5
	B	9.8	S	1.55	11.7
	MB-1	9.0	S		14.0
1987	A	15.4	S + CN	3.1	14.3
	B	12.2	S	1.70	10.9
	MB-1	9.0	S		14.0
1992	A	20.0	S + CN	3.3	13.0
	B	15.3	S	2.00	10.3
	MB-1	9.0	S		14.0
1997	A	24.5	S + CN + F	5.0	13.4
	B	18.0	S	1.85	9.9
	MB-1	9.0	S		14.0
TOTAL CAPITAL COST				29.6	
Alternative 6 Two Plants and Existing Plants MB-1, NMB-1, NMB-2, AF-1, LB-1					
1977	A	6.2	S	3.3	12.8
	B	6.55	S	3.4	13.0
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0

Table 4-4 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 6 (continued)					
1982	A	9.0	S + PN	1.5	11.7
	B	8.55	S	1.55	12.0
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1987	A	13.2	S + CN	3.1	14.6
	B	10.95	S	1.70	11.2
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1992	A	20.0	S + CN	4.3	13.1
	B	15.2	S	2.5	10.4
	MB-1[2]	9.0	S		14.0
1997	A	24.4	S + CN + F	5.0	15.7
	B	18.0	S	1.9	9.9
	MB-1[2]	9.0	S		14.0
TOTAL CAPITAL COST				28.2	
Alternative 7 Two Plants and No Existing Plants					
1977	A	17.4	S	7.7	10.0
	B	7.8	S	3.9	12.2
1982	A	20.2	S + CN	4.0	13.2
	B	9.8	S	1.6	11.5
1987	A	24.4	S + CN	3.1	12.5
	B	12.2	S	1.7	11.1
1992	A	29.0	S + CN	3.3	12.0
	B	15.3	S	2.0	10.4

Table 4-4 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 7 (continued)					
1997	A	33.4	S + CN + F	5.4	14.0
	B	18.0	S	1.9	10.0
TOTAL CAPITAL COST				34.6	

[1] Treatment Code Letters: S - Secondary, CN - Complete Nitrification, PN - Partial Nitrification, F - Filtration.

[2] All Existing Plants but MB-1 Phase Out.

[3] O & M: The annual average operation and maintenance cost of the treatment plant.

Table 4-5

Wastewater Treatment Plant Requirements - Three Plant Alternative
Grand Strand 201 Facilities Plan

Year	Plant	Flow, mgd	Required[1] Treatment	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 8 Three Plants and No Existing Plants					
1977	A	17.4	S	7.6	10.0
	C	1.8	S	2.1	18.0
	G	6.0	S	3.0	13.0
1982	A	20.2	S + CN	4.1	13.0
	C	2.4	S	0	16.5
	G	7.4	S	1.3	12.4
1987	A	24.4	S + CN	3.1	12.6
	C	3.3	S	1.65	15.4
	G	8.9	S	1.3	12.0
1992	A	29.0	S + CN	3.3	12.0
	C	4.5	S	0	14.0
	G	10.7	S	1.5	11.3
1997	A	33.4	S + CN + F	5.5	14.0
	C	5.5	S	0	13.5
	G	12.5	S	1.5	11.0
TOTAL CAPITAL COST				35.9	
Alternative 9 Three Plants and Existing Plants MB-1, NMB-1, NMB-2, AF-1, LB-1					
1977	A	6.2	S	3.6	13.1
	C	1.3	S	2.9	16.0
	G	5.25	S	2.9	13.5
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0

Table 4-5 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
		Alternative 9 (continued)			
1982	A	9.0	S + PN	1.5	11.7
	C	1.9	S	0	15.0
	G	6.65	S	1.25	12.8
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1987	A	13.2	S + CN	3.1	14.6
	C	2.8	S	1.9	13.4
	G	8.15	S	1.30	12.0
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1992	A	20.0	S + CN	4.3	13.1
	C	4.5	S	0	12.0
	G	10.7	S	1.80	11.3
	MB-1[2]	9.0	S		14.0
1997	A	24.4	S + CN + F	5.0	15.7
	C	5.5	S	0	11.0
	G	12.5	S	1.50	10.6
	MB-1[2]	9.0	S		14.0
TOTAL CAPITAL COST				31.0	
		Alternative 10 Three Plants and Existing Plant MB-1			
1977	A	8.4	S	4.1	11.5
	C	1.8	S	2.05	15.0
	G	6.0	S	3.2	13.0
	MB-1	9.0	S		14.0

Table 4-5 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 10 (continued)					
1982	A	11.2	S + CN	1.9	9.5
	C	2.4	S	0	14.0
	G	7.4	S	1.25	12.4
	MB-1	9.0	S		14.0
1987	A	15.4	S + CN	2.5	10.6
	C	3.3	S	1.65	12.5
	G	8.9	S	1.30	11.8
	MB-1	9.0	S		14.0
1992	A	20.0	S + CN	4.1	9.5
	C	4.5	S	0	12.0
	G	10.7	S	1.50	11.3
	MB-1	9.0	S		14.0
1997	A	24.4	S + CN + F	2.8	9.2
	C	5.5	S	0	11.0
	G	12.5	S	1.45	10.6
	MB-1	9.0	S		14.0
TOTAL CAPITAL COST				27.8	

Table 4-6

Wastewater Treatment Plant Requirements - Four Plant Alternative
Grand Strand 201 Facilities Plan

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 11 Four Plants and No Existing Plants					
1977	C	1.8	S	2.1	15.0
	D	10.8	S + PN	5.7	11.2
	F	6.6	S	5.0	12.8
	G	6.0	S	3.0	13.0
1982	C	2.4	S	0	14.0
	D	12.3	S + PN	1.4	10.5
	F	7.9	S	0	12.1
	G	7.4	S	1.3	12.4
1987	C	3.3	S	1.65	12.5
	D	15.3	S + CN	3.0	14.0
	F	9.1	S + PN	2.3	11.8
	G	8.9	S	1.3	12.4
1992	C	4.5	S	0	12.0
	D	18.1	S + CN	7.4	13.5
	F	10.9	S + PN	0	11.2
	G	10.7	S	1.5	11.3
1997	C	5.5	S	0	11.0
	D	20.9	S + CN	2.4	13.0
	F	12.5	S + PN	0	10.8
	G	12.5	S	1.5	11.0
TOTAL CAPITAL COST				39.55	
Alternative 12 Four Plants and Existing Plant MB-1					
1977	C	1.8	S	2.1	15.0
	D	1.8	S + PN	1.7	17.0
	F	6.6	S	5.0	12.8
	G	6.0	S	3.0	13.0
	MB-1	9.0	S		14.0

Table 4-6 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 12 (continued)					
1982	C	2.4	S	0	14.0
	D	3.3	S + PN	1.4	15.5
	F	7.9	S	0	12.1
	G	7.4	S	1.3	12.4
	MB-1	9.0	S		14.0
1987	C	3.3	S	1.65	12.5
	D	6.3	S + CN	2.5	18.0
	F	9.1	S + PN	2.3	11.8
	G	8.9	S	1.30	12.0
	MB-1	9.0	S		14.0
1992	C	4.5	S	0	12.0
	D	9.1	S + CN	2.4	16.5
	F	10.9	S + PN	0	11.2
	G	10.7	S	1.5	11.4
	MB-1	9.0	S		14.0
1997	C	5.5	S	0	11.0
	D	11.9	S + CN	2.4	15.3
	F	12.5	S + PN	0	10.8
	G	12.5	S	1.5	11.0
	MB-1	9.0	S		14.0
TOTAL CAPITAL COST				30.55	
Alternative 13 Four Plants and Existing Plants MG-1, NMB-1, NMB-2, AF-1, LB-1					
1977	C	1.3	S	2.90	16.0
	D	1.8	S + PN	1.7	17.0
	F	4.4	S	2.6	14.0
	G	5.25	S	2.90	13.5
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0

Table 4-6 (continued)

Year	Plant	Flow, mgd	Required Treatment[1]	Capital Cost $Million	O & M[3] Cost, ¢/ 1,000 Gal.
Alternative 13 (continued)					
1982	C	1.9	S	0	15.0
	D	3.3	S + PN	1.4	15.5
	F	5.7	S	1.2	13.2
	G	6.65	S	1.25	12.8
	MB-1	9.0	S	1.2	13.2
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1987	C	2.8	S	1.9	13.4
	D	6.3	S + CN	2.5	18.0
	F	6.9	S + PN	1.6	12.5
	G	8.15	S	1.30	12.0
	MB-1	9.0	S		14.0
	NMB-1	1.0	S		6.0
	NMB-2	1.2	S		6.0
	AF-1	.75	S		17.0
	LB-1	0.5	S		24.0
1992	C	4.5	S	0	12.0
	D	9.1	S + CN	2.4	16.5
	F	10.9	S + PN	2.2	11.2
	G	10.7	S	1.80	11.3
	MB-1[2]	9.0	S		14.0
1997	C	5.5	S	0	11.0
	D	11.9	S + CN	2.4	15.3
	F	12.5	S + PN	1.5	10.8
	G	12.5	S	1.50	10.6
	MB-1	9.0	S		14.0
TOTAL CAPITAL COST				34.25	

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[1] Treatment Code Letters: S - Secondary, CN - Complete Nitrification, PN - Partial Nitrification, F - Filtration.

[2] All existing Plants but MB-1 Phase Out.

[3] O & M: The annual average operation and maintenance costs of the treatment plant.

The present worth and annual equivalent costs for each of the 13 treatment plant alternatives, including plant outfalls and site costs are summarized in Table 4-7. These costs were computed using a 7 percent interest rate.

4.3.3 Transmission System Alternative Evaluation

This section provides an evaluation of the direct resources costs of the four regional transmission system configurations to serve the Grand Strand Planning Area to Year 1997.

The monetary costs of the preceding transmission systems were determined and compared based on present worth and annual equivalent costs for providing equal service to the total planning area for the total planning period.

The cost-effectiveness evaluation of system alternatives necessitates a preliminary design of each alternative based on the provision of total and equal service to the planning area.

The design criteria is summarized as follows:

- Average daily flow is 100 gallons per capita per day based on peak seasonal population estimates of the Waccamaw Regional Planning and Development Council, not including day visitors.
- Regional pumping stations and force mains are sized for maximum daily flow for the peak tourist season projected for year 1997.
- Maximum daily flow is determined by multiplying average daily flow by the following numbers:

Multiplier	Condition
1.0	Used only when a flow equalization tank is to be constructed at a given pumping station to permit the leveling of flows over a 24-hour period.
2.0	Used where average daily flows are greater than 0.5 mgd.

Table 4-7

Present Worth and Annual Equivalent Cost For Wastewater Treatment Alternatives Grand Strand 201 Facilities Plan

Treatment Alternatives	Treatment Plant Costs		Plant Outfalls		Plant Site Costs[1]		Total Costs for Treatment Alternative[4]	
	Present Worth $	Annual Equivalent Cost, $	Present Worth $	Annual Equivalent Cost, $	Present Worth $	Annual Equivalent Cost, $	Present Worth $	Annual Equivalent Cost, $
1. Plant E & No. Existing Plants	65,356,300	6,169,000	374,900	35,400	575,000	73,150	65,731,200	6,204,400
2. Plant E & All Existing[2]	47,405,200	4,474,600	316,800	29,900	635,000	60,000	48,040,200	4,504,400
3. Plant E & All Existing[3]	25,835,100	2,438,600	7,436,000	701,900	635,000	60,000	33,271,100	3,140,500
4. Plant E & Plant MB-1	49,954,200	4,715,200	316,800	29,900	635,000	60,000	50,271,000	4,745,100
5. Plants A & B & Plant MB-1	33,380,300	3,150,800	1,872,000	176,700	635,000	60,000	35,252,300	3,327,500
6. Plants A & B & All Existing	30,941,800	2,920,600	1,822,000	172,000	635,000	60,000	32,763,800	3,092,600
7. Plant A & B & No Existing	35,525,300	3,353,200	1,872,000	176,700	575,000	73,150	37,397,300	3,529,900

Treatment Alternatives	Treatment Plant Costs		Plant Outfalls		Plant Site Costs[1]		Total Costs for Treatment Alternative[4]	
	Present Worth $	Annual Equivalent Cost, $	Present Worth $	Annual Equivalent Cost, $	Present Worth $	Annual Equivalent Cost, $	Present Worth $	Annual Equivalent Cost, $
8. Plant A & C & G & No Existing	37,441,700	3,534,100	1,999,000	188,700	680,000	64,200	39,440,700	3,722,800
9. Plants A, C & G & All Existing	34,444,000	3,251,300	1,820,000	172,800	500,000	47,200	36,264,000	3,424,000
10. Plants A, C & G & Plant MB-1	35,132,200	3,316,100	1,908,800	180,200	500,000	47,200	37,041,000	3,496,300
11. Plants C, D, F & G	39,695,000	3,746,800	1,707,600	161,200	620,000	58,500	41,402,600	3,908,000
12. Plants C, D, F & G & MB-1	37,067,300	3,498,800	1,612,500	152,200	480,000	45,300	38,679,200	3,651,000
13. Plants C, D, F & E & All Existing	37,187,700	3,510,100	1,612,500	152,200	480,000	45,300	38,800,200	3,662,300

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[1] Plant site costs are estimated at $5,000 per acre, allowing 2 acres per mgd for secondary treatment and 3 acres per mgd for higher levels.

[2] Intracoastal Waterway Discharge.

[3] Waccamaw River Discharge.

[4] The costs for plant site are not included in the total costs for alternatives as the salvage value at the end of the planning period is assumed equal to original acquisition cost.

Multiplier	Condition
2.5	Used where average daily flows are 0.3 mgd to 0.5 mgd.
2.75	Used where average daily flows are less than 0.3 mgd.

- Pumping station heads are determined on the basis that all stations are being operated on a common force main. Total dynamic head is limited to 170 feet (68 psi).
- Repump stations are limited to cases where there is economic advantage. Generally, common force mains are used with intermediate pumping stations injecting into the mains rather than repumping the total flow.
- The velocity of flow in force mains is limited from 2.5 to 8.0 feet per second.
- The "C" factor, or roughness coefficient, for the cast iron and ductile iron force mains varies according to pipe size, as follows:

Pipe Size	"C" Factor
10", 12"	110
14"	115
16"	120
20", 24", 30", 36"	125
42" and larger	130

The present worth and annual equivalent cost of each of the various transmission system alternatives is shown in Table 4-8. The present worth of each system equals initial cost plus the present worth of the annual average operating and maintenance costs. Average annual equivalent costs equals the present worth times the capital recovery factor based on a 20 year term at 7 percent interest.

Table 4-8

One Plant Transmission System Alternative		
Present Worth of:		
Pumping Stations	$10,300,000	
Force Mains	23,390,000	
Flow Equalization Tanks	1,821,600	
Average Annual Operating & Maintenance Cost	6,267,400	
Total Present Worth =		$41,779,000
Annual Equivalent Cost		
$41,779,000 x 0.09439 =		$ 3,943,900
Two Plants Transmission System Alternative		
Present Worth of:		
Pumping Stations	$10,360,000	
Force Mains	19,090,000	
Flow Equalization Tanks	1,632,400	
Average Annual Operating & Maintenance Cost	4,671,400	
Total Present Worth =		$35,753,800
Annual Equivalent Cost		
$35,753,800 x 0.09439 =		$ 3,375,200

Table 4-8 (continued)

Three Plants Transmission System Alternative		
Present Worth of:		
Pumping Stations	$ 9,550,000	
Force Mains	18,490,000	
Flow Equalization Tanks	1,632,400	
Average Annual Operating & Maintenance Cost	4,431,100	
Total Present Worth =		$34,115,500
Annual Equivalent Cost		
$34,115,500 x 0.09439 =		$ 3,220,500
Four Plants Transmission System Alternative		
Present Worth of:		
Pumping Stations	$ 8,940,000	
Force Mains	16,380,000	
Flow Equalization Tanks	737,000	
Average Annual Operating & Maintenance Cost	4,277,000	
Total Present Worth =		$30,334,900
Annual Equivalent Cost		
$30,334,900 x 0.09439 =		$ 2,863,600

Thus, it is seen that the four plant transmission system has the lowest monetary cost, measured in terms of present worth and annual equivalent cost.

4.3.4 Cost Summary of the Alternatives

The cost summary of each of the thirteen alternatives is presented in Table 4-9 in terms of Average Annual Equivalent Costs. These costs include both capital and operation and

Table 4-9

Alternative Cost Comparison

Treatment Alternatives	No. of New Plants	Average Annual Equivalent Cost	Percent Above Lowest Cost
1. Plant E & no existing	One	10,148,300	56.9
2. Plant E & all existing Intracoastal Discharge	One	8,448,300	30.6
3. Plant E & all existing Waccamaw River Discharge	One	7,084,400	9.5
4. Plants E & MB-1	One	8,689,000	34.3
5. Plants A, B & MB-1	Two	6,702,700	3.6
6. Plants A, B, & all existing	Two	6,467,800	Lowest
7. Plants A & B, no existing	Two	6,905,100	6.8
8. Plants A, C, & G, no existing	Three	6,943,300	7.4
9. Plants A, C, & G, all existing	Three	6,644,500	2.7
10. Plants A, C, G & MB-1	Three	6,716,800	3.8
11. Plants C, D, F & G	Four	6,771,600	4.7
12. Plants C, D, F, G & MB-1	Four	6,514,600	0.7
13. Plants C, D, F, G & all existing	Four	6,525,900	0.9

maintenance costs of the treatment plants and transmission lines.

As seen in this table, Alternative 6 is the least cost alternative with all other alternatives within 10 percent of the cost of Alternative 6 except for Alternatives 1, 2, and 4.

4.3.5 Comparison of Alternatives

A discussion of the beneficial and detrimental impacts of the alternatives is presented in this section. A rating of 0 to 10 points is assigned to each alternative for each effect identified. A rating of 5 indicates neither a beneficial nor a detrimental impact but a neutral impact. Numbers from 6 to 10 represent a beneficial impact with 10 being the most beneficial, while numbers from 4 to 0 represent a detrimental impact with 0 being the most detrimental. The rationale for the point assignments is presented in the discussion of each identified impact. However, it should be mentioned that this method is somewhat subjective and is based on the reviewer's best judgement. Table 4-11 at the end of this section summarizes the overall ratings.

4.3.5.1 Environmental Effects

Aquatic Biota - All alternatives are designed to provide the level of treatment required to meet water quality standards. Therefore, all alternatives would be expected to be equal in affect on aquatic biota. However, recent studies have shown that residual chlorine has a detrimental effect on the productivity of fish and macroinvertebrates inhabiting areas downstream of wastewater treatment plant outfalls. It has been observed that residual chlorine levels as low as 0.2 to 0.04 mg/l can be toxic to aquatic life. The residual chlorine concentration in the effluent from each of the wastewater plants is expected to be about 0.5 mg/l. Alternative 1 (one regional plant with no existing plants) would discharge 51.4 mgd (79.5 cfs) to the Intracoastal Waterway just north of Route 501. This alternative would result in the largest single discharge to the Intracoastal Waterway of any alternative. With an effluent concentration of 0.5 mg/l and a July low average tidal flow of approximately 2,160 cfs, the residual concentration within the Intracoastal Waterway outside of the effluent plume would be about 0.04 mg/l. Therefore, no toxicity should exist from any alternative as a result of residual chlorine after effluent dispersion.

It should be noted, however, that residual chlorine levels will be high enough within the effluent plumes to be toxic and the size of the plumes will vary depending upon the tidal movement of the Waterway and the volume of effluent discharged. The alternative which has a greater distribution of wastewater flow along the Waterway will be less likely to affect the aquatic ecosystem. Therefore, the more treatment plants in an alternative, the higher its rating. An exception to this is the No Action Alternative since its effect on the aquatic biota is worse than any chlorine effect. Therefore, it is rated 0.

Terrestrial - All alternatives are designed to provide maximum protection to land features and plant life thereon. The removal of numerous pollution sources, delineation of areas of environmental concern, and identification of endangered plant species are ways in which the improvements of this plan can be constructed and operated with fullest protection to terrestrial features. (There will, however, be some minor temporary construction effects which will require restoration and thus, the more land required to build the lower amount of points given.) The following table shows the amount of land required to build the treatment facilities and pipeline r/w for each alternative.

Table 4-10

Land Area Requirements

Alternative	Land Required* - acres	Points Awarded
1	165	1
2	177	0
3	177	0
4	177	0
5	167	1
6	167	1
7	155	2
8	176	0
9	140	3
10	140	3
11	154	2
12	126	4
13	126	4
No Action	0	5

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* The land requirements were figured on the basis of 2 acres/mgd for secondary treatment and 3 acres/mgd for higher treatment. Pipelines that were not alongside of a roadway were measured and a 20' r/w assumed to obtain an acreage.

Wildlife Habitat - None of the plans will result in the destruction of any significant wildlife habitat. However, any change in the use of land which is currently utilized by wildlife will be a negative impact. Therefore, the larger the land requirements, the lower the rating.

Cultural - The location of historical, archeological and environmental features as part of this plan provides assurance that known cultural features will be protected. The possibility of disturbing unknown features is related more to the acreage disturbed than the number of sites. Therefore, the same rating given to an alternative in the "Terrestrial" section will be given here.

Groundwater and Surface Water Pollution - Since all alternatives are designed to meet water quality standards, each alternative is ranked equally except the No Action alternative which is given a 0.

Air Pollution - The Grand Strand Region is not considered a critical area from the standpoint of air pollution. Since none of the alternative plans use sludge incinerators, there will be no air pollution and all alternatives are rated at 5.

Construction Impacts/Noise, Dust - The construction of any treatment plant alternative will be in isolated areas of the region and will not produce significant construction disturbances. Each alternative, if implemented, would result in temporary noise and dust during construction. Alternative plans with more treatment plant construction would generally produce more construction disturbances. This is somewhat encountered in the one regional plant alternative in that more interceptor construction would be necessary. The one regional plant plan is given a 3, the two regional plant plan a 4, the three regional plant a 3, and the four regional plant plan a 2. No Action is rated at 5.

Land Use - All treatment plant sites for each alternative plan have been reviewed with local and regional land regulatory and planning authorities and each plan is compatible with present and future land use. The alternative plans which use the Litchfield Beach Plant have had their rating reduced by one point because this plant is located in a flood prone area. The plant site, however, can be flood proofed to protect it from the intermediate regional flood.

In the past, the unavailability of regional wastewater facilities has not impeded growth in the planning area.

Septic tanks and package plants were readily installed to serve new developments. As a result, the current condition in the Grand Strand is the existence of between 50 and 60 package plants. However, despite the apparent ease with which new package plants are installed, the more regionalized the wastewater management plan, the more opportunities exist for inducing development. This is particularly true of the plans employing one regional plant. Interceptors would virtually extend from one end of the Grand Strand to the other through undeveloped areas, many of which are valuable natural or semi-natural areas.

For this reason, all plans employing one regional plant will loose 3 points, plans utilizing two regional plants will loose 2 points, and plans using both three or four regional plans will loose no points. The No Action alternative is rated at 3 since many of the existing package plants conflict with present and future land use.

Social Factors/Dislocation/Disturbance - There will be no dislocation of residents or businesses due to the construction of any of the alternatives. There will be some disturbance to the local residents during construction of interceptors through streets and highway rights-of-way. This disturbance is expected to be very nearly equal regardless of which alternative plan is selected. Therefore, all alternatives are rated at 5 with the exception of the No Action Alternative which will receive a 3, not because of construction activity, but because of the many complaints of local residents to septic tank effluent problems in many communities.

Social Factors/Employment Changes - The only employment changes will be the hiring and training of qualified operators for the wastewater treatment and collection systems. The overall effect will be favorable giving some advantage to multiple plant configurations over fewer plants. Therefore, the one and two plant plans are given a rating of 8 and the three and four plant plans are rated at 9. If the alternative continues the use of the existing plants, it will receive one additional point. The No Action Alternative is rated at 5.

4.3.5.2 Monetary Effects

All costs were presented in Tables 4-3 through 4-8 and the Average Annual Equivalent Cost of each plan was presented in Table 4-9. The rating in this section is obtained by assigning a rating of 9 to the least cost alternative and any alternative within 10 percent of it. A rating of 8 is applied to alternatives within 11 percent to 20 percent, 7 for 21 percent to 30 percent, 6 for 31 percent to 40 percent, 5 for 41 percent to 50 percent, and 4 for 51 percent to 60 percent. The No Action Alternative is rated at 10.

4.3.5.3 Contributions to Water Quality Objectives and Other Water Management Goals

The implementation of all alternatives will result in the maximum feasible contributions to water management's goals within the limits of cost-effectiveness. Although it would be desirable to proceed to zero discharge of effluent and total recycling of the treated effluent, this is not feasible in all cases in the Grand Strand Region. It has been pointed out that soil conditions and seasonally high water tables are the major constraint to irrigation with effluent. This is particularly true in the southern and central regions of the Grand Strand. If land application were a part of any plan, that plan would receive a higher rating. Since the northern portion of the planning area appears to be the only area which has any possibility of land application of effluent, the three and four plant plans which more centrally locate plants in the northern area are given a slightly higher rating.

The three plant configuration which locates plants in the three critical pollution areas will be more compatible with a phased program eliminating major pollution sources early in the implementation period. Therefore, the three plant configurations receive a 9, the four plant plans an 8, the one and two plant plans a 7, and the No Action Alternative receives a 0.

4.3.5.4 Implementation Capability

Critical institutional, financial, and legal problems will arise if the one or two plant configuration is selected over the three or four plant scheme. The Georgetown Water and Sewer District has recognized the critical pollution problems developing in the Litchfield Beach area and has constructed a 0.5 mgd wastewater treatment plant and transmission system to relieve the current stress. It will likely not support a plan which does not expand upon the pollution control program already in progress. It is willing to transfer untreated wastewater from the area of Georgetown County north of Brookgreen Gardens and Huntington State Park to a regional plant in Horry County, but is not willing to sacrifice the progress it has made in the lower Waccamaw Neck. For this reason, and the acceptability of the plants in Horry County with the local government officials, the alternatives that use the three and four plant configurations are rated 9, the alternatives that use the one or two plant configurations are rated 5, and the No Action alternative is rated 0 points since there are problems in these areas that must be alleviated.

4.3.5.5 Energy and Chemical Use

The more treatment plants there are in an alternative, the more energy and chemicals it is likely to use. However, looking also at the transmission systems, the alternatives using only one plant will use more power than alternatives with two, three or four plants. Therefore, the rating is as follows: one plant scheme 3, two plant scheme 4, three plant scheme 3, four plant scheme 2, and No Action alternative 1, since it has many package plants. The rating will be reduced by 1 point for the alternatives using all existing plants.

4.3.5.6 Reliability

The frequency of plant upsets in the modern secondary treatment plants and those with higher levels of treatment is extremely low with proper operation. The opportunity for upsets, however, is greater with a plan incorporating more plants. Upon this basis, the rating would be the same as that used for the "Air Pollution" Section. The exception is the rating given the No Action alternative which is zero since it has many plants in use that have a high probability for an upset.

The frequency of spills in the new wastewater treatment plants should be zero with proper operation. This is based on the experience of many years of operating similar plants in other areas. The frequency of spills for the existing aerated oxidation ponds is greater and should be considered. There are no combined sewers in the existing or proposed collection and transmission systems. The frequency and effects of sewer overflows in the transmission system will be negligible due to the provision of standby equipment and emergency procedures. It was pointed out earlier in this report that considerable opportunity for sewer overflows exists in the existing collection systems in the region due to the lack of full capacity and standby equipment in many of the pumping stations operated by the municipalities. Thus, all alternatives will be rated 10 except the alternative using the existing plants which will be rated 9. The No Action alternative will be rated 0 for the poor functioning of the many existing systems and the use of oxidation ponds.

4.3.5.7 Summary of Evaluation

A summary of the impacts is presented in the Evaluation Matrix, Table 4-11. It is recognized that some impacts are more important than others in determining the best alternative. In an effort to reflect this fact, an Importance Factor has been assigned to each identified impact. The Importance Factor is a percentage of 1 so that the sum of all importance factors is equal to 1. The rating assigned to each alternative for each identified impact is multiplied by the Importance Factor to obtain a number termed Value. The Total of the Values for each alternative represents the overall Rank. If this number is less than 5, the overall impact of the alternative is detrimental. The higher the rating above 5 the more beneficial the alternative.

As seen in Table 4-11, Alternatives 8, 9 and 10 have the highest total Values. Based on these ratings and the fact that Alternative 9 has the lowest Average Annual Equivalent Cost of the three best alternatives, Alternative 9 was the selected alternative.

4.4 EVALUATION OF SEVEN ADDITIONAL ALTERNATIVES

4.4.1 General

As stated at the beginning of this Chapter, the identification and analysis of alternatives will be accomplished in two phases. The first phase of this analysis resulted in the selection of Alternative 9 as the proposed action. Alternative 9 is the construction of three regional wastewater plants (Plants A, C and G) in addition to the continued use of existing plants MB-1, NMB-1, NMB-2, AF-1, and LB-1. All existing plants except MB-1 would be phased out in 1992.

As a condition of the November 21, 1975 approval of the Grand Strand Facilities Plan, the South Carolina Department of Health and Environmental Control required the analysis of seven additional alternatives effecting the north and central service areas. This additional alternative analysis was necessary as a result of the findings during

Table 4-11
Evaluation Matrix

	Alternatives	No Action		1		2		3		4		5	
	Importance Factor	Rating/Value		Rating/Value		Rating/Value		Rating/Value		Rating/Value		Rating/Value	
1. Environmental Effects													
a. Aquatic Biota	.05	0	0	4	.2	6	.3	6	.3	4	.2	6	.3
b. Terrestrial	.01	5	.05	1	.01	0	0	0	0	0	0	1	.01
c. Wildlife Habitat	.01	5	.05	1	.01	0	0	0	0	0	0	1	.01
d. Cultural Areas	.03	5	.15	1	.03	0	0	0	0	0	0	1	.03
e. Groundwater and Surface Water Pollution	.10	0	0	10	1.00	10	1.00	10	1.00	10	1.00	10	1.00
f. Air Pollution	.01	5	.05	5	.05	5	.05	5	.05	5	.05	5	.05
g. Construction Impacts	.04	5	.2	3	.12	3	.12	3	.12	3	.12	4	.16
h. Land Use	.03	3	.09	7	.21	6	.18	6	.18	7	.21	8	.24
i. Social Factors													
1. Dislocation & Disturbance	.01	3	.03	5	.05	5	.05	5	.05	5	.05	5	.05
2. Employment	.02	5	.1	8	.16	9	.18	9	.18	8	.16	8	.16
Subtotal	.31		.72		1.84		1.88		1.88		1.79		2.01
2. Monetary Costs	.31	10	3.10	4	1.24	6	1.86	9	2.79	6	1.86	9	2.79
3. Contributions to Water Quality Objectives	.15	0	0	7	1.05	7	1.05	7	1.05	7	1.05	7	1.05
4. Implementation Capability	.05	0	0	4	.20	4	.20	4	.20	4	.20	4	.20
5. Energy & Chemical Use	.08	1	.08	3	.24	2	.16	2	.16	3	.24	4	.32
6. Reliability													
a. Frequency of Plant Upset	.05	0	0	10	.50	9	.45	9	.45	10	.50	8	.40
b. Frequency of Spills	.05	0	0	10	.50	9	.45	9	.45	10	.50	10	.50
TOTAL	1.00		3.90		5.57		6.05		6.98		6.14		7.27

le 4-11
ion Matrix

5		6		7		8		9		10		11		12		13	
Rating/Value		Rating/Value		Rating/Value		Rating/Value		Rating/Value		Rating/Value		Rating/Value		Rating/Value		Rating/Valu	
6	.3	7	.35	6	.3	7	.35	8	.4	7	.35	8	.4	8	.4	9	.45
1	.01	1	.01	2	.02	0	0	3	.03	3	.03	2	.02	4	.04	4	.04
1	.01	1	.01	2	.02	0	0	3	.03	3	.03	2	.02	4	.04	4	.04
1	.03	1	.03	2	.06	0	0	3	.09	3	.09	2	.06	4	.12	4	.12
10	1.00	10	1.00	10	1.00	10	1.00	10	1.00	10	1.00	10	1.00	10	1.00	10	1.00
5	.05	5	.05	5	.05	5	.05	5	.05	5	.05	5	.05	5	.05	5	.05
4	.16	4	.16	4	.16	3	.12	3	.12	3	.12	2	.08	2	.08	2	.08
8	.24	7	.21	8	.24	8	.24	7	.21	8	.24	8	.24	8	.24	9	.27
5	.05	5	.05	5	.05	5	.05	5	.05	5	.05	5	.05	5	.05	5	.05
8	.16	9	.18	8	.16	9	.18	10	.20	9	.18	9	.18	9	.18	10	.20
	2.01		2.05		2.06		1.99		2.18		2.14		2.10		2.20		2.30
9	2.79	9	2.79	9	2.79	9	2.79	9	2.79	9	2.79	9	2.79	9	2.79	9	2.79
7	1.05	7	1.05	7	1.05	9	1.35	9	1.35	9	1.35	8	1.20	8	1.20	8	1.20
4	.20	4	.20	4	.20	9	.45	9	.45	9	.45	9	.45	9	.45	9	.45
4	.32	3	.24	4	.32	3	.24	2	.16	3	.24	2	.16	2	.16	1	.08
8	.40	7	.35	8	.40	6	.30	5	.25	6	.30	4	.20	4	.20	3	.15
10	.50	9	.45	10	.50	10	.50	9	.45	10	.50	10	.50	10	.50	9	.50
	7.27		7.13		7.32		7.62		7.63		7.77		7.40		7.50		7.[illegible]

the development of the EIS that the population projections used in the Facilities Plan were excessive, and the water quality of the Intracoastal Waterway and the Waccamaw River was worse than originally believed.

4.4.2 Alternatives to be Evaluated

The following seven alternatives have been evaluated. They have been assigned roman numerals to avoid confusion with the previously evaluated 13 alternatives.

I. Discharge existing Plant "MB-1" and North Plant "A" into the Intracoastal Waterway. The specified level of treatment to meet water quality criteria is 10 ppm BOD_5 and suspended solids and 2 ppm NH_3. It was agreed that the required type of treatment is secondary plus nitrification and filtration. Chlorination is required for all treatment levels.

II. Utilize existing Plant "MB-1" effluent for public land spreading (spray irrigation of golf courses and other public land). It was agreed that the required type of treatment is secondary plus filtration.

Discharge North Plant "A" effluent into the Intracoastal Waterway with the type of treatment specified in I above.

III. Utilize North Plant "A" effluent for public land spreading with the type of treatment specified in II above.

Discharge existing Plant "MB-1" effluent into the Intracoastal Waterway with the type of treatment specified as in I above.

IV. Utilize existing Plant "MB-1" effluent for rural land application on IPC land northwest of Intracoastal Waterway. The type of treatment specified is 85 percent BOD_5 and SS removals. Discharge North Plant "A" effluent into the Intracoastal Waterway with the type of treatment specified in I.

V. Utilize North Plant "A" effluent for rural land application on IPC land northwest of Intracoastal Waterway, with 85 percent BOD_5 and SS removals, as the specified treatment.

Discharge existing Plant "MB-1" into the Intracoastal Waterway with type of treatment as specified in I.

VI. Utilize existing Plant "MB-1" and North Plant "A" effluents for rural land application on IPC land northwest of the Intracoastal Waterway, with 85 percent BOD_5 and SS removals as the specified treatment.

VII. Transfer the maximum practicable untreated effluent from the service areas of North Plant "A" and existing Plant "MB-1" to Central Plant "G" for discharge to the Waccamaw River.

The following changes from the original Facilities Plan have been applied to the analysis of the seven new alternatives:

- The population projections have been reduced in accordance with the EIS findings.
- The waste production value of 100 gpcd, average daily flow, for permanent residents is accepted but the waste production value for tourists and day visitors has been reduced from 75 gpcd to 50 gpcd for tourists (overnight transients) and 25 gpcd for day visitors.
- The water quality criteria for effluent discharged to the Intracoastal Waterway requires not more than 10 mg/l BOD_5 and suspended solids and 2 mg/l ammonia.
- The effluent criteria for discharge to the Waccamaw River allow secondary treatment up to 6 mgd if the discharge from Plant "G" is relocated to the vicinity of the confluence with the Pee Dee River. The effluent limitations to flows greater than 6 MGD at the "G" site has yet to be determined.
- The capacity of the aerated oxidation pond for plant MB-1 was found to be excessive and was downgraded from 9 mgd to 7.4 mgd.

All interceptors and wastewater plant capacities have been reduced to correspond with the revised population projections. In addition, plants discharging to the Intracoastal Waterway have been upgraded to provide the required treatment levels. It is noted that all alternatives involve land application of effluent with the exception of Alternatives I and VII.

4.4.3 Alternative Evaluation

The seven alternatives and their respective treatment plant discharge locations, design capacities, and required treatment for each phase, are summarized in Table 4-12. A comparison of the capital and annual O&M costs is summarized in Table 4-13. It is seen in this table that Alternative I, which is essentially the same as Alternative 9, is the lowest in capital costs and Alternative V is the second lowest. The remaining alternatives range from 18 percent to 39 percent higher than Alternative I.

Alternative V has the lowest annual operating and maintenance cost while Alternative I and III are second lowest at about 10 percent higher than Alternative V during Phase 1, 18 percent higher during Phase 2, and 20 percent higher in Phase 3. Alternative III has a much higher capital cost than either Alternatives I or V. On the basis of the cost analysis, Alternatives I and V were considered further in the Facilities Plan Supplementary Engineering Report.

4.4.4 Plan Section

Alternative I is essentially the selected plan of the Facilities Plan with adjustment in wastewater facilities sizes and quality of effluent discharges based on new population projections, waste production values, and water quality criteria. The outfall sewer for Wastewater Plant G has been relocated to the Waccamaw River near its confluence with the Pee Dee River which provides improved stream flows and thus higher quality water. Existing Plant "MB-1" and the Environs Sewer System are utilized throughout the planning period with a higher degree of treatment required for the MB-1 plant during Phase 1.

Alternative V changes the Intracoastal Waterway discharge of Wastewater Treatment Plant "A" to the use of treated effluent for rural land spreading on 1,470 acres of land in the northern portion of the Grand Strand. In addition, a 40 acre holding pond at the land application site is provided to hold up to 7 days flow, Wastewater Treatment Plant A is designed to be a 130 acre aerated wastewater stabilization pond rather than a mechanical wastewater treatment plant. It would be capable of 85 percent removal which

ALT.	PHASE No.	WWTP DISCHARGE "A"	WWTP DISCHARGE "MB-1"	WWTP DISCHARGE "G"	DESIGN CAPACITY, MGD, ADF. "A"	DESIGN CAPACITY, MGD, ADF. "MB-1"	DESIGN CAPACITY, MGD, ADF. "G"	TREATMENT REQUIRED "A"	TREATMENT REQUIRED "MB-1"	TREATMENT REQUIRED "G"
No. 1	1	ICWW	ICWW	Wacc.R.	6.0	7.4	6.0	Sw+N+F	Sw+N+F	Sw
	2	ICWW	ICWW	Wacc.R.	8.0	8.0	6.0	Sw+N+F	Sw+N+F	Sw
	3	ICWW	ICWW	Wacc.R.	10.0	9.0	7.5	Sw+N+F	Sw+N+F	Sw*
No. 2	1	ICWW	PLS	Wacc.R.	6.0	7.4	6.0	Sw+N+F	Sw+F	Sw
	2	ICWW	PLS	Wacc.R.	8.0	8.0	6.0	Sw+N+F	Sw+F	Sw
	3	ICWW	PLS	Wacc.R.	10.0	9.0	7.5	Sw+N+F	Sw+F	Sw*
No. 3	1	PLS	ICWW	Wacc.R.	6.0	7.4	6.0	Sw+F	Sw+N+F	Sw
	2	PLS	ICWW	Wacc.R.	8.0	8.0	6.0	Sw+F	Sw+N+F	Sw
	3	PLS	ICWW	Wacc.R.	10.0	9.0	7.5	Sw+F	Sw+N+F	Sw*
No. 4	1	ICWW	RLS	Wacc.R.	6.0	7.4	6.0	Sw+N+F	S_L	Sw
	2	ICWW	RLS	Wacc.R.	8.0	8.0	6.0	Sw+N+F	S_L	Sw
	3	ICWW	RLS	Wacc.R.	10.0	9.0	7.5	Sw+N+F	S_L	Sw*
No. 5	1	RLS	ICWW	Wacc.R.	6.0	7.4	6.0	S_L	Sw+N+F	Sw
	2	RLS	ICWW	Wacc.R.	8.0	8.0	6.0	S_L	Sw+N+F	Sw
	3	RLS	ICWW	Wacc.R.	10.0	9.0	7.5	S_L	Sw+N+F	Sw*
No. 6	1	RLS	RLS	Wacc.R.	6.0	7.4	6.0	S_L	S_L	Sw
	2	RLS	RLS	Wacc.R.	8.0	8.0	6.0	S_L	S_L	Sw
	3	RLS	RLS	Wacc.R.	10.0	9.0	7.5	S_L	S_L	Sw*
No. 7	1	ICWW	WWTP "G"	Wacc.R.	6.0	Transfer	12.5	Sw+N+F	Transfer	Sw*
	2	ICWW	WWTP "G"	Wacc.R.	8.0	To	14.5	Sw+N+F	To	Sw*
	3	ICWW	WWTP "G"	Wacc.R.	10.0	WWTP "G"	16.0	Sw+N+F	WWTP "G"	Sw*

Phase 1 = 1978-1982
Phase 2 = 1982-1987
Phase 3 = 1987-1997

ICWW = Intracoastal Waterway
Wacc.R. = Waccamaw River
PLS = Public land spreading (golf courses, etc.)
RLS = Rural land spreading (agricultural land West of ICWW)

Sw = Secondary to surface waters (30 ppm BOD_5 & SS)
S_L = Secondary to land spreading (85 percent BOD_5 & SS removal)
N = Nitrification
F = Filtration
* = Further study required

Table 4-13
Comparison of Capital and O&M Costs for Seven (7) Alternatives
Grand Strand 201 Facilities Plan

Alternative No. & Description	Capital Cost, $1,000, By Phase Phase 1	Phase 2	Phase 3	TOTAL	O&M Costs, $1,000, By Phase Phase 1	Phase 2	Phase 3
No. 1 WWTP's "A" & "MB-1" discharge to Intracoastal Waterway & WWTP "G" discharges to Waccamaw River	18,616	12,364	5,100	34,080	870	1,235	1,537
No. 2 WWTP "A" discharges to Intracoastal Waterway, WWTP "MB-1" to public land spreading, & WWTP "G" to Waccamaw River	24,282	14,864	2,600	41,746	1,012	1,372	1,715
No. 3 WWTP "A" to public land spreading WWTP "MB-1" to Intracoastal Waterway, & WWTP "G" to Waccamaw River	24,506	11,364	4,400	40,270	888	1,208	1,505
No. 4 WWTP "A" to Intracoastal Waterway, WWTP "MB-1" to rural land spreading, & WWTP "G" to Waccamaw River	26,282	14,749	4,100	45,131	1,267	1,627	1,965
No. 5 WWTP "A" to rural land spreading WWTP "MB-1" to Intracoastal Waterway & WWTP "G" to Waccamaw River	21,444	11,534	4,278	37,256	795	1,032	1,366
No. 6 WWTP's "A" & "MB-1" to rural land spreading & WWTP "G" to Waccamaw River	30,950	12,079	4,388	47,417	1,183	1,450	1,774
No. 7 WWTP "A" to Intracoastal Waterway, WWTP "MB-1" diverted to WWTP "G", & WWTP "G" to Waccamaw River	24,336	13,888	4,500	42,724	1,280	1,705	1,844

is required for land application according to the South Carolina Department of Health and Environmental Control. Plants G and MB-1 would remain the same as in Alternative I.

A 1977 present worth analysis was performed on both these alternatives including both capital and O&M costs for all three phases. The present worths are as follows:

- Alternative I - $38,658,000
- Alternative V - $38,205,000

Alternative V is only 1 percent less costly than Alternative I.

Alternative V has the following advantages:

- Zero discharge to the Intracoastal Waterway will provide maximum protection to its water quality.
- The nutrients in the effluent of Plant "A" would be utilized to enrich the quality of native grasslands and forests.
- Maximum protection would be provided to the Little River Inlet thus assisting in reopening the area for shellfishing.
- The spray irrigation site could be used as a public park or natural area.

Unfortunately, an evaluation of the soils indicates a seasonally high water table through most of the area which precludes the land application on such a large scale. This same soil limitation applies to all the other alternatives which utilize land application.

As a result, Alternative I is the selected plan.

CHAPTER 5

PROPOSED ACTION

5.1 GENERAL

Based on a review of the water quality model for the Intracoastal Waterway and Waccamaw River, the Technical Support Branch of U.S. EPA, Region IV recommended the following effluent limitations to meet the South Carolina Department of Health and Environmental Control stream standards:

- Plants A and MB-1 (plants discharging to the Intracoastal Waterway) must meet maximum treatment limits, i.e., BOD = 10 mg/l; ammonia = 2 mg/l; effluent DO = 5 mg/l.
- Plants discharging to the Waccamaw River in the vicinity of the confluence of the Pee Dee River (Plants G and C) must meet secondary treatment limits. However, before Plant G is expanded beyond 6 mgd, additional stream water quality data must be collected to calibrate the water quality model in that portion of the stream.

5.2 GENERAL DESCRIPTION OF PROPOSED FACILITIES

Previous chapters have detailed the selection process from subsystem analysis through alternative definitions and analysis. The costs and environmental concerns were analyzed and a preferred alternative was selected. The proposed action is presented in this chapter and shown in Figure 4-1.

The proposed action is designed to be implemented in three phases. In Phase I (1978-1982), three new regional treatment plnats (A, C, and G) are to be constructed to serve the most critical areas. Existing plant MB-1 is to be upgraded to provide secondary treatment with complete nitrification and filtration. Existing plants NMB-1, and AF-1 will be phased out in 1972 and plant NMB-2 will be phased out in 1982. Plant LB-1 will be incorporated into Plant C. I Phase II (1982-1987), all existing plants except MB-1 will be phased out. Periodic expansion and process upgrading will be required during Phase III (1987-1997) as flows increase.

Table 5-1 shows the phasing of the proposed action with flow, costs, and treatment required.

Table 5-1
Phasing of Proposed Action

	WWTP's	WWTP Discharge	Treatment Required	Design Capacity	Capital Costs $1,000	O & M Costs $1,000
Phase I (1978-1982)	A	ICWW	S+N+F	6.0	7,083	421
	C(1)	Wacc.R.	S	2.4	4,617	149
	G	Wacc.R.	S	6.0	9,883	366
	MB-1	ICWW	S+N+F	7.4	1,650	83
	NMB-1(2)					
	NMB-2 (2)	ICWW	OP+F	1.2		
	AF-1(2)					
Phase II (1982-1987)	A	ICWW	S+N+F	8.0	7,777	649
	C	Wacc.R.	S	3.6	2,264	232
	G	Wacc.R.	S	6.0	4,472	498
	MB-1	ICWW	S+N+F	8.0	115	88
Phase III (1987-1997)	A	ICWW	S+N+F	10.0	2,600	737
	C	Wacc.R.	S	4.8	1,495	314
	G	Wacc.R.	S+N+F	7.5	2,500	728
	MB-1	ICWW	S(3)	9.0	0	92

Legend

(1) Plant C incorporates LB-1
(2) Plant phased out
(3) Further study required
ICWW - Intracoastal Waterway
Wacc.R. - Waccamaw River
S - Secondary treatment (30 mg/l BOD$_5$ & SS)
S+N+F - Secondary treatment plus nitrification plus filtration (10 mg/l BOD$_5$, 2 mg/l ammonia, and 5 mg/l effluent DO)
OP+F - Oxidation pond plus filtration
T - Trickling filter

5.3 DETAILED DESCRIPTION OF SUBSYSTEM

The following section provides more detail of the proposed action.

5.3.1 Transmission Systems

A pressure system is used to transmit flows to the major plants. Existing gravity systems are unchanged. The proposed sizing for the force mains is given in Table 5-2. Preliminary design considerations for the pressure systems are summarized as follows:

- Widely varying flow conditions that would cause septicity, settlement of solids and blockages in non-tourist seasons.
- Soil conditions that are incompatible with deep gravity sewers.
- Virtual elimination of inflow/infiltration in regional transmission lines.
- The use of the widest practical range of pressure flow velocities to minimize pipe sizes and the effects of potential growth, and to facilitate phase construction.

The phasing of transmission system construction is based on the principle that the minimum lines will be installed to intercept the maximum pollution. Consideration is also given to utilizing the maximum capacities of the existing treatment facilities. The proposed alternative ideally meets the preceding guidelines as one plant is proposed for location in each of the three most critical pollution areas of the Grand Strand.

Two existing transmission systems have been included in the regional plan: the Myrtle Beach Environs Sewer, and the Litchfield Beach system of the Georgetown County Water and Sewer District. The Myrtle Beach Environs Sewer is primarily a pressure system.

There are two basic methods for connecting gravity and pressure sewers into the regional transmission lines. One method is to tie directly into a master lift station wet well of the transmission system. The second method is to connect a force main directly to the pressure pipeline with a tee

Table 5-2

Pipe Diameters* for Plant "C" Force Mains

Force Main Location From - To	Pipe Diameter (Inches)
10-JCT-2	8
18-JCT2	4
10-JCT3	6
10-JCT4	8
JCT2-JCT3	16
JCT3-JCT4	18
JCT4-JCT5	18
2A-JCT1	6
2B-JCT2	4
2C-EB	4
2D-JCT1	6
JCT1-JCTB	16
3A-JCT1	12

*Black, Crow & Eidsness, Inc.

Table 5-2 (Continued)

Pipe Diameters* for Plant "A" Force Mains

Force Main Location From - To	Pipe Diameter (inches)
ED-JCT4	20
EA-JCT4	20
JCT4-EC	20
EC-EB	20
EB-MB	20
2A-1B	20
2B-2A	20
2C-Plant	24
2D-2C	20
2E-2D	16
2F-Plant	14

*Black, Crow and Eidsness

Table 5-2 (Continued)

Pipe Diameters* for Plant "G" Force Mains

Force Main Location From - To	Pipe Diameter (Inches)
1A-JCT5	8
1E-1D	4
1D-1C	10
1C-1B	16
1G-1B	6
1B-JCT2	20
1F-JCT2	14
MBAFB-1F	10
JCT2-JCT4	30
JCT4-JCT5	30
JCT5-Plant	30
2A-JCT3	12
2D-2C	12
2G-2F	8
2F-2C	16
2C-2B	20
2B-JCT3	20
JCT3-JCT4	20

*Black, Crow & Eidsness

and plug valve or sleeve and tapping valve. In the latter method, the hydraulics of the transmission line and the connected force main must be reviewed to assure optimum flow conditions.

Combinations of gravity/force main interceptors will be utilized to the extent possible in the detailed design work. More precise field surveys should make certain sections of gravity sewers more cost-effective in the final design process.

5.3.2 Flow Equalization Tanks

Major economies are realized in transmission and treatment costs for instances where wastewater flow equalization tanks (F.E.T.) are feasible. An advantage of the F.E.T. is that it provides storage during the peak flow hours each day and in so doing, permits the connected pumping station and ensuing pipeline to be designed for average daily flow rather than maximum daily flow. This is even more beneficial due to the seasonal nature of flows in the study area.

The flow equalization tanks provide a further advantage of leveling flows to the treatment plant improving plant efficiency and reducing total costs.

A preliminary design of the proposed alternative concludes that two wastewater flow equalization tanks are feasible (F.E.T. No. 1 and No. 2) in the plan for the North Plant "A" servcie area.

Conditions do not warrant the use of flow equalization tanks in the transmission systems leading to Plants C and G. Also, flows will not require construction of F.E.T. Tanks No. 1 until Phase III and No. 2 until Phase II (completion by 1981).

The primary advantages of utilizing flow equalization tanks in the regional transmission system for Plant A are summarized, as follows:

- There is a reduction in pipe size for the 12 mile force main from F.E.T. No. 1 to Plant A.
- Flow into wastewater treatment Plant A can be controlled for steady flow during peak seasonal

conditions, eliminating shock maximum loads and thus providing improved, uniform treatment levels.

- The outfall for wastewater treatment Plant A can be designed for 20-year peak season average daily flow rather than maximum daily flow, again resulting in a smaller pipe size and steadier discharge to the Intracoastal Waterway.

The following design considerations are included in the wastewater flow equalization tanks:

- Aeration facilities will be provided to control septicity and odor problems. A backup hydrogen peroxide feed system will also be provided for this purpose.
- Tank bottoms will be sloped and withdrawals will be at the lowest point to minimize collection of solids. A backup flushing system will be provided for daily washdown of tanks.
- The flow equalization tanks can be bypassed during seasons when flows do not require their use.

5.3.3 Wastewater Treatment Systems

The regional wastewater treatment system utilizes acceptable existing treatment plnats to their full capacity to minimize flows to the new facilities. This greatly facilitates minimizing new construction and the phasing of implementation to reduce capital costs consistent with low operation and maintenance costs.

Treatment plant configurations using small modular systems are designed for new facilities to accommodate the wide variance in flows between the permanent and peak tourist seasons. Maximum flexibility in treatment system operation is maintained by the diversion of flows between the existing and new regional plants.

As previously mentioned, the flow equalization tank preceding the North Plant (A) facilities uniform loading to the plant during peak load conditions, and minimizes the size of the connected transmission pipelines and the plant outfall discharge line.

Acceptable existing package wastewater treatment plants are utilized on an interim basis to minimize both the initial size of new region treatment plants and the extension of the regional transmission systems.

Sludge treatment and handling is accomplished through the use of aerobic digestion and sludge drying beds. The dried sludge can then be utilized as a soil fertilizer and conditioner for golf courses. Experimentation should also be conducted with direct liquid spraying of sludge from the digesters. Following Phase I, three options will be available for sludge handling processes:

- The elimination of the sludge drying beds and direct spraying of digested sludge, if this method has proven acceptable;
- The development of a sod farm and nursery, similar to the one now in operation in St. Petersburg, Florida, utilizing liquid; and
- The development of a product similar to Milorganite for sale to golf courses.

5.4 MANPOWER NEEDS

The need for trained operation and maintenance personnel in the Grand Strand Planning Area is evidenced by the generally unacceptable conditions of numerous wastewater collection and treatment systems. Attainment of the water management goals of the region are greatly dependent upon the recruitment and training of key personnel to operate and maintain the existing and proposed regional wastewater systems.

5.5 NON-STRUCTURAL ACTIONS

There are non-structural actions which may reduce flows significantly. These may be used separately or in conjunction with one another. The implementation of these actions are discussed below.

The control of non-point sources needs further study which is being done in the 208 plan for this area.

Improved operation and maintenance techniques will require the hiring of more qualified personnel. This will increase current costs.

Public educational programs and legislation of flow and waste reduction devices are left to the local governing body to initiate.

CHAPTER 6

PRIMARY IMPACTS ON THE NATURAL ENVIRONMENT

6.1 SURFACE WATER

The proposed wastewater treatment plants have both positive and negative effects on surface water quality. The proposed plan for three wastewater treatment plants will improve surface water quality by eliminating pollutants from septic system discharges and by eliminating runoff or overflow from sewage lagoons. These pollutants presently contaminate creeks and streams as a result of rainwater runoff.

6.1.1 Rivers and Estuaries

Water quality in the Waccamaw River will be improved to meet state water quality standards, despite the increased pressures of residential development and recreation. Water quality in approximately one half of all shellfishing areas currently violates Class SA standards. Improvement in water quality will result in opening these areas for shellfishing, with the posible exception of Winyah Bay, where a major industrial source of pollution exists.

6.1.2 Intracoastal Waterway

A potential primary negative effect is the projected continued discharge into the Intracoastal Waterway, which amounts to a current peak discharge (1974) of 9.9 MGD with varying types of secondary treatment. The proposed plan calls for plant "G" and MB-1 to discharge an average flow of 16.18 MGD into the Intracoastal Waterway by 1997 with tertiary treatment. This may still result in failure to meet specified criteria, primarily as a result of natural conditions. South Carolina regulations state that "the specified standards will not be considered violated when values outside the established limits are caused by natural conditions." Furtherfore, "where wastes are discharged to such waters, the discharges shall not be considered a contribution to substandard conditions... provided maximum treatment is maintained."

In recent years, research studies have shown that residual chlorine has a detrimental effect on the productivity of fish and macroinvertebrates inhabiting areas below secondary treatment plant outfalls. As a result of these studies, it was found that these organisms can tolerate residual levels of 0.2 to .04 mg/l where intermittent chlorination is done for periods up to 2 hours a day. Based on the results of these studies, an instant chlorine discharge of 0.47 mg/l was recommended. Without additional information, it is believed that the continuous level of residual chlorine will be below 0.01 mg/l, and therefore, will have little or no effect on the aquatic life.

6.1.3 Coastal Waters

The area's local commerce depends upon recreation (golf and coastal recreation) opportunities. Improvement of the beach water quality will improve the area's desirability. Urban runoff to the coastal waters includes pollutants such as organic material with high biological oxygen demand (BOD), suspended solids (SS), and significant amounts of other pollutants (air pollution, oil and grease, herbicides, chemical fertilizers, and pesticides). The extent to which pollution of the beaches will be abated can not be quantified at this time.

6.1.4 Effects of Sewer Lines on Waters

The proposed plan will require the construction of approximately 87 miles of force mains ranging in size from 4 inches to 36 inches. Force main effects on surface waters are expected to be minimal since the proposed lines will be constructed and located along existing roads. However, two water crossings are planned and consist of one 18-inch line crossing the Intracoastal Waterway on Route 544 and one 30-inch line crossing the waterway close to the Briarcliff Condominiums near Crescent Beach. Construction effects on the waterway at these crossings may include increases in turbidity, suspended solids, and sewage. The extent of these effects will be dependent on the channel flow and specific bottom composition.

6.2 GROUNDWATER

The proposed plan is expected to improve groundwater quality substantially, especially the water table aquifer. At the present time, sanitary waste discharges from septic systems are contaminating this aquifer by percolation and/or seepage. With the proposed wastewater treatment facilities, the groundwater quality will most likely be improved enough to comply with present drinking water standards.

6.3 WATER-LAND INTERFACES

The coastline of the study area consists of several types of water-land interfaces, including: beaches, estuaries and salt marshes, and fresh water marshes. Several shellfish areas are presently closed because of high coliform counts (sewage bacteria) as a result of discharges from oxidation ponds, treatment plants, malfunctioning septic tanks, and urban runoff. These areas are located within or near: Murrell's Inlet, Pawley's Island, Litchfield Beach, Little River Inlet, and Cherry Grove.

6.3.1 Murrell's Inlet

Murrell's Inlet is currently open to shellfishing on a conditional basis. It is closed when rainfall exceeds 3 inches or when monitoring so indicates. The Murrell's Inlet area should show the most significant improvement in terms of lower coliform counts. The lower bacteria results in more sanitary beaches and fishing areas. Much of this area is currently served by septic tanks, and sewered wastes are treated only by oxidation ponds and small treatment plants. The proposed plan calls for the "phasing out" of the oxidation ponds and for providing sewer service to the area. Treated effluent from this area will be discharged into the Waccamaw River.

6.3.2 Pawley's Island

The Pawley's Island area is largely served by septic tanks, except for the Pawley's Island apartments. Projected sewer service will reduce sewage seepage permeation in the immediate area.

6.3.3 Litchfield Beach

Much of the Litchfield Beach area is currently served by sewers and treatment plants which discharge into Clubhouse Creek. Some improvement in the immediate area will be realized by discharging treated wastewater into the Waccamaw River and extending service to the unsewered area.

6.3.4 Cherry Grove and Little River

The Cherry Grove and Little River area is largely served by septic tanks, except for an area within two blocks of the coast which is served by sewers. Two plants serve, respectively, two trailer parks farther inland. Since the proposed plan calls for Plant A to provide secondary treatment during Phase I and more sophisticated treatment during Phases II and III (including spray irrigation), most of the pollution load of the area will be removed.

In summary, the negative impacts of the proposed action on the coastline water-land interfaces are expected to be minimal, and the positive impacts will most likely be substantial.

6.3.5 Floodplains

Inland water-land interfaces, consisting predominantly of floodplains, are not expected to be affected significantly by the proposed treatment plants. Site WWTP "C" is the only site of the three located within a floodplain. The size of the floodplain associated with this site is approximately 5 miles long by 5 miles wide. Since the width of the plant facility is expected to be approximately 1,400 feet, or about 5 percent of the floodplain channel, the construction and operation of the treatment facility is expected to have only a minor effect on the biological productivity of the floodplain.

6.3.6 Effects of Sewer Lines on Water-Land Interfaces

With respect to the proposed plan's force main lines, one 8-inch line will be adjacent to or will traverse an estuary near Atlantic Avenue, between Magnolia Beach and Pawley's Island. This estuary lies at the northeastern end of the approved shellfish harvesting area and oyster bed, and some effects due to construction are expected. These effects are likely to be caused by runoff and siltation.

6.4 LAND FEATURES

6.4.1 Topography

Topographic features of the planning region are not expected to be altered significantly due to the construction and operation of the wastewater treatment plants and associated sewer lines. Therefore, natural drainage patterns will not be affected, from the overall project standpoint. Minor changes in drainage patterns, however, are expected to occur within the vicinity of each site, mainly due to major grading operations which will be necessary for site preparation.

Of the three proposed plant sites, site WWTP "C" will experience the largest topographic change. This site is located in a flood-prone area (elevation less than 20 feet) which is delineated as a potential 100-year flood area. The elevation marker closest to the site indicates an elevation of 12 feet. The proposed facility will require approximately 142,000 cubic yards of fill to raise the plant site to a 20-foot minimum elevation for floodproofing purposes. Other floodproofing measures include constructing dikes around the plant site and covering the facility to protect the electrical and mechanical equipment. These floodproofing measures are expected to result in minor changes in the site's drainage patterns. These changes are not expected to affect drainage in surrounding areas.

6.4.2 Geology

The proposed project is not expected to alter or change the geological characteristics of the planning region or plant sites.

6.4.3 Soil

The construction of approximately 87 miles of force mains, ranging in size from 4 inches to 36 inches, is expected to require the excavation of about 1.2 million cubic yards of soil over a 20-year period. A similar volume will be excavated in operations at each proposed plant site. Changes in the soil's physical (erosion) and chemical (soil nutrients) characteristics may result during these operations. The changes, however, are expected to be short term and minimal at any given time since construction will be spread over a 20-year period.

Large borrow pits, in which soil is removed and used as backfill or for floodproofing, will affect the physical characteristics of the soil in the vicinity of the pit areas. These areas will be susceptible to erosion and siltation due to rainwater runoff during the construction phases of the proposed plan. The backfill or floodproofing areas will also be susceptible to erosion and siltation if the soil is improperly compacted.

Land disposal of sewage sludge, which can be done using filling and spreading methods, is likely to alter the chemical make-up or nutrient composition of the soil in the vicinity of the disposal site. The effects can either be positive or negative depending on the site's soil conditions and characteristics.

6.4.4 Vegetation

In general, the type of overstory vegetation located on and around the proposed treatment plant sites is undisturbed forestland consisting of predominantly loblolly pine, water oak, wax myrtle, and sweet gum trees of varying densities. The main understory vegetation on each site includes rhododendron, sassafras, fetter-bush, summer grape, and muscadine. Both vegetation types provide habitats for the area's wildlife, and removal may affect the delicate balance of this ecosystem. The effect, however, is expected to be minimal and no rare or endangered species' habitats will be affected. (See Appendix F)

Vegetation in the vicinity of the proposed sites and sewer line routes are summarized in Table 6-1, and the plants listed represent the dominant or most common species. Results of vegetative surveys of the sites for Plants A, C and G and their outfalls, are summarized below:

- Plant A — 20-25 Acres Plus a 9240 Foot Outfall. Ninety percent of the plant site area was six year old planted loblolly, now dead because of the Horry County Fire of April 1976. The other ten percent was scattered pond pine, BA 30, and dense bayberry and gallberry bushes, also killed but now sprouting back. Lesser vegetation now consists of wire grass, broom straw, small bayberry and gallberry bushes 6-18 inches high, and other natural grasses on higher ground (still a wet area sandy soil) where planted pines were.

  The outfall runs along a primitive dirt road (industry logging and access road) for 6600 feet, then through a Corps of Engineers spoil area for waterway dredging for 2640 feet. No

Table 6-1
Vegetation of the Proposed Sites and Sewer Line Routes*

Species Type	WWTP-A**		WWTP-C&G	Sewer Line
	#1 Area	#2 Area		
Trees	Sweet Gum Loblolly Pine Wax Myrtle Red Maple	Loblolly Pine Wax Myrtle Sweet Gum	Water Oak Sweet Gum Turkey Oak Loblolly PIne	Turkey Oak Longleaf Pine Scrubby Post Oak
Herbaceous	*Saururus* sp. Toadflax *Viola* sp. *Mitchella* sp. *Polygala* sp. Dog Fennel	Broom Sedge Thistle Cud Weed	Stinging Nettle Blue-eyed Grass *Mitchella* sp.	Stinging Nettle Broom Sedge
Woody	Yellow Jessamine Summer Grape Muscadine Virginia Creeper Poison Oak *Decumaria* sp.	Rhododendron *Baccharis* sp. Upland Sumac *Lyonia* sp.	Yaupon Holly American Holly Sassafras Fetter-bush Poison Ivy Summer Grape Muscadine	Sassafras Rhododendron Fetter-bush

* Reference Source: Black, Crow & Eidsness, Inc., "Master Plan of Wastewater Facilities (201 Facilities Plan)", June 1974.

** Two areas sampled for this sight.

vegetated area will be affected along the road, and the spoil area consists of dead sand and desert vegetation, a few scattered small cedars, kudzu vines from waterway bank, and another creeping vine.

- Plant G — 25 Acres Plus a 13,860 Foot Outfall The plant site is an old pasture used for open grazing up until 10 years ago. It now consists of wire grass and broom straw, a few myrtle bushes, and very scattered longleaf and loblolly pine saplings. The area has been abanddoned for farming and is not classified as woodland. The entire area (200+ acres) burns every two or three years for unknown reasons.

  The outfall runs along a dirt road right-of-way, and includes native grasses and no forest land except for a 25 foot strip at the corner of a field. This contains scrub oak, briars, honeysuckle vines, and a small grapevine.

- Neither plant site nor outfall area contains any historical trees, rare or unusual size specimens. No harmful impact on any sensitive vegetation is evident. Appropriate measures need to be taken to prevent erosion of the high bank where the outfall enters the intracoastal waterway.

- Plant C.— The plant site is the current site for the Litchfield Beach plant. The new outfall will cross little actual timber land. The route crosses an abandoned rice field where the primary vegetation type would be saw-grass and some myrtle species. No significant or endangered vegetation was noted along this corridor.

6.4.5 Wildlife

Clearing operations of each proposed site are expected to have an effect on some of the wildlife habitats in or near the sites. In addition, various species of birds, mammals, and reptiles, who utilize the food resources of each site, will be affected. The impact, however, is not likely to be severe since habitats and food resources abound in each site area and are within the range of the wildlife. Rare and endangered species have not been sighted in or near any proposed site.

6.5 ATMOSPHERIC ENVIRONMENT

6.5.1 Odor

The prevailing winds of the Grand Strand planning region are generally from the north and northeast during the fall and winter seasons and from the south and southwest during the spring and summer seasons. Odors originating from the operation of wastewater treatment systems are expected to affect residents downwind from each plant site. This effect is expected to be significant up to a distance of approximately one mile from the plant. Beyond one mile, odors will most likely dissipate and rapidly reach a negligible level. During stagnant conditions when wind speeds are less then 0.5 meters/second, odors will have a significant effect on residents within the vicinity of the plant. This condition, however, will only occur on an average of two days per year.

6.5.2 Noise

During the construction phase of the proposed project, noise from earthmoving vehicles and other motor- or pneumatic-driven equipment is expected to cause a significant short term adverse effect on residents near the proposed plant sites. Typical noise levels of construction vehicles and equipment are listed in Table 6-2 in units of dbA (decibels - A scale) for a given distance. The extent of construction noise on the residents will be local, within a one-quarter-mile radius from the center of the activities.

6.6 SENSITIVE NATURAL AREAS

Activities associated with the construction and operation of wastewater treatment facilities at the proposed site WWTP "A" may have a minor effect on two sensitive natural areas: the Carolina Bays and the Buist Forest Preserve (game management area). The edges of several bays area adjacent to the road leading to the site and heavy truck traffic to and from the site may have an effect on some of the rich vegetative growth within 100 feet of this road. Fugitive roadway dust and vehicle exhaust pollutants are expected to be the primary sources of these effects. The same effect is expected at the northeast boundary of the Buist forestland. These potential impacts will be thoroughly evaluated by vegetative surveys during design of these lines.

Table 6-2
Typical Noise Levels of Construction Equipment

Equipment	Noise Levels in dB (A) at 50' (without noise controls)*	Important Noise Sources**
EARTHMOVING		
front loaders	79	E C F I H
backhoes	85	E C F I H
dozers	80	E C F I H
tractors	80	E C F I W
scrapers	88	E C F I W
graders	85	E C F I W
truck	91	E C F I T
paver	89	E D F I
MATERIALS HANDLING		
concrete mixers	85	E C F W T
concrete pumps	82	E C H
cranes	83	E C F I T
derricks	88	E C F I T
STATIONARY		
pumps	76	E C
generators	78	E C
compressors	81	E C H I
IMPACT		
pile drivers	101	W P E
jack hammers	88	P W E C
rock drills	98	W E P
pneumatic tools	86	P W E C
OTHER		
saws	78	W
vibrators	76	W E C

* Estimated levels obtainable by selecting quieter procedures or machines and implementing noise control features requiring no major redesign or extreme cost

** In order of importance:

T	power train and gearing	F	cooling fan
C	engine casing	W	tool-work interaction
E	engine exhaust	H	hydraulics
P	pneumatic exhaust	I	engine intake

Source: "Noise from Construction Equipment and Operatings, Building Equipment and Home Appliances," U.S. Environmental Protection Agency, Office of Noise Abatement and Control, December 31, 1971.

Construction activities and operations of wastewater treatment facilities at sites WWTP "C" and "G" will not have any effect on sensitive natural areas. The nearest sensitive natural area to site WWTP "C" is the Brookgreen Gardens area, approximately two miles northeast of the site. For site WWTP "G", the Waccamaw Game Management forestland is the nearest sensitive area and is approximately two miles north of the site.

Sewer line construction activities associated with the proposed WWTP "A" plant may cause some adverse effects to the Buist Game Management forestland and a few of the Carolina Bays. These potential impacts will be thoroughly evaluated by vegetative surveys during the design of these lines.

CHAPTER 7

PRIMARY IMPACTS ON THE MANMADE ENVIRONMENT

7.1 LAND USE

The proposed regional wastewater treatment system will cause no significant changes in use of land adjacent to the treatment plant sites. Of the proposed system components, treatment plant C has the highest potential for impact on land use in the planning area. Section 7.1 discusses the land use of each component of the proposed system. It is organized into the following parts:

- Treatment System C
- Treatment System G
- Treatment System A
- Distribution System for Treated Effluent
- Sludge Disposal System.

7.1.1 Treatment System C

The construction and subsequent operation of plant C is proposed for the Litchfield section of Georgetown County. The proposed site for plant C is the site of an existing 0.5 MGD treatment plant, which would be expanded from its current 1.1 acres to about 10.1 acres. Currently, relatively large homes on large lots are situated to the northeast and east of the site, on the edges of a growing community. The community is designed around a golf course and country club. Low density homes built around recreational facilities, a golf course, or some combination of golf courses, lakes, and tennis courts, will continue to be a major use of land in the planning area. To the north, west, and south of the existing plant and the proposed site are wooded undeveloped areas, a large portion of which is recently harvested commercial timberland.

The existing treatment plant will affect the future use of land around the Litchfield Country Club, and the proposed plant would have effects similar to the existing plant. Both plants would preclude development of several prime lots in the community; those directly across from the entrance to the plant and those along its northwest boundary. The proposed plant would, however, preclude the development of more lots because of the much greater length of its boundaries along prime lots for development. Neither the continued use of the existing plant nor the development of the proposed plant would curtail expansion of the community in the westerly direction. Adequate wooded areas around the plant would provide a buffer zone between the expanding community and the site.

The proposed plant would utilize the sewage transmission facilities of the existing plant, as well as its outfall route. Therefore, these portions of the system would not adversely affect land use. The existing facilities serve Litchfield Beach and the Litchfield Country Club area. Proposed transmission facilities would follow the present roadways which connect the existing and proposed plant to Pawley's Island, the Sea Gull Golf Club area, and the sparsely developed areas, along Route 17, south of the Sea Gull Golf Club. No changes in land use would result from the construction of the proposed transmission system for plant C.

7.1.2 Treatment System G

The proposed site for plant G is an overgrown pasture remote from all but sparse rural development. The construction and operation of proposed plant G would increase the site development level from low to intense, but would be compatible with surrounding land use; a mix of pasture and overgrown pasture. There are about four dwellings near the proposed site. The two closest are located approximately 300 feet to the northeast and 500 feet to the west. Impact on these homes would not be severe enough to require relocation of the occupants and subsequent change in land use.

The proposed transmission system for plant G follows existing roadways along most of its length. It departs from existing Route 544 for a short distance near proposed pumping station 2C, and follows the boundary between existing agricultural land and commercial forest. It would cause no significant change in land use. The outfall also follows existing roadways for most of its length and would cause no significant changes to the existing agricultural or wooded lands.

7.1.3 Treatment System A

The proposed location for treatment plant A is in commercial forest remote even from sparse rural development. Here, as with plant G, the change in level of land use is from low to intense, but the surrounding area remains free from development pressures. An existing cleared powerline right of way forms a buffer zone between the northern boundary of the site and a roadway. The only economic activity in the surrounding area, commercial forestry, is compatible with the construction and operation of the proposed plant. The closest dwellings are approximately one mile from the proposed site and should be only slightly affected by the project.

Construction of the proposed outfall to the Intracoastal Waterway and of the proposed sewage transmission system to plant A would follow existing roadways for most of their length, and would cause no land use changes. In those few cases where lines depart from roadways, they cut through short, wooded stretches with no major development. Therefore, they will cause no significant changes in land use.

7.1.4 Sludge Disposal System

The proposed action is to sell sludge in a form usable for golf course turf fertilization. Sludge disposal on golf courses has been used successfully in other parts of the country and can be expected to be compatible with golf course use here.

7.2 ARCHEOLOGICAL, HISTORICAL, AND RECREATIONAL AREAS

7.2.1 Archeological Resources

The proposed regional wastewater treatment system was designed so that construction of transmission lines, distribution lines, pumping stations, and flow equalization tanks would not disturb known archeological sites. Much of the length of proposed transmission and distribution mains follows existing major highways such as Route 17, where ditches have probably already destroyed any archeological resources which might have been there. Further investigation of archeological resources is being done under a special EPA grant. An archeological survey for the Plant G site, outfall, and interceptor system is presented in Appendix G. Surveys for the other plant sites are now underway and will be included in the final EIS.

7.2.2 Historical Resources

The proposed treatment system would cause no disturbance to any of the area's historical resources. These resources are unaffected for three reasons. First, no historical sites fall within the proposed boundaries or within the immediate vicinity of the three proposed treatment plant sites. Secondly, the vast majority of the sewage transmission systems and treated effluent distribution systems would be along existing roadways. None of the historical sites in the area are close enough to the proposed routes to suffer disturbance during construction or operation of the proposed facilities. Thirdly, where the transmission and distribution system leaves the roadways, it has no historical sites in its path.

7.2.3 Recreational Resources

During construction of the proposed facilities, only the recreation of golfers and hunters would be inconvenienced. During the operation of the proposed facilities, no recreation would be affected.

Since each of the three transmission systems follows roads bordered partly by golf courses, golfers would be exposed to temporary sight and noise of construction. However, none of the impacts of construction would interfere with golf course use.

During the construction of treatment plant "A" transmission system, hunters in the Buist Game Management area might be temporarily restricted in their access to the northeast portion of the area because of construction vehicle traffic. Construction would occur during Phase II of the project, and would cause less impact than would land preparation for new home construction expected at that time. Therefore, the impact on recreation is not serious to the Buist Game Management area.

7.3 TRANSPORTATION

Construction and operation of the proposed facilities would not significantly interfere with transportation facilities in the area. The principal effects would be temporary; where transmission or distribution pipelines would cross the road, causing auto and truck traffic slowdowns and lane diversions and contributing to congestion of the roadway. There are two methods of laying pipe across a roadway: boring under or trenching across. Boring under causes little if any impediment of traffic. It would be the preferred method, especially in crossing major Routes 17 and 501. Use of this method depends on soil conditions in the roadbed. Therefore, the roadbed would be tested on-site. Trenching across the roadway, the second method, would be done where boring is not feasible. Trenching would result in some traffic congestion. However, abundant measures to lessen the impact of trenching across roadways exist. They are discussed in the chapter on mitigative measures.

Of the three proposed treatment systems, construction of the Phase II transmission lines for treatment plant "G" would have the greatest potential impact on traffic. The transmission line would cross Route 501 near the Wolverine Brass Company and American Gear and Pinion, Inc. Should trenching across the roadway be necessary, scheduling the operation during the "off" season for tourists would minimize adverse effects on traffic on this important access route to the area's beaches.

Two transmission mains are proposed to cross the Intracoastal Waterway. These crossings would be built so that no significant impediments to the Waterway's boat or barge traffic would occur.

7.4 RESOURCE USE

Most sources of building materials, chemicals, energy, and capital consumed by the project are located outside the planning area. Project consumption of these resources would not affect their availability for other projects in the area.

A total of about $18 million* in building materials would be spent by the three proposed treatment plants over their three project phases. Resource materials consumed by outfalls, pumping stations, and force mains would cost a total of about $13 million. The treated effluent distribution system for spray irrigation would consume materials worth about $6 million. The facilities' chlorine consumption at full flow, or 42.6 MGD, would be about 1732 tons per year of this chemical resource.

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* All values are given in January, 1975 dollars.

Electrical energy consumption for the proposed facilities would be less than 2 percent of the consumption by residents and motels in the area. At full flow, 42.6 MGD, proposed facilities would consume approximately the following amounts of electric power:

.	Plant C:	4,600 Kwh/day
.	Plant G:	12,000 Kwh/day
.	Plant A:	21,000 Kwh/day

This is a total of 37,600 Kwh/day.* This rate of consumption could be easily supplied by the electricity generation and distribution system.

The labor force used in constructing the proposed facilities would be drawn both from within the planning area and from the nearby communities in Horry and Georgetown Counties. The required labor force for each phase of construction is discussed in Section 7.6, Community Services and Facilities.

Consumption of capital is treated in Section 7.7, User Charges.

7.5 WATER PROGRAMS

The three proposed wastewater treatment plants discharge into the Intracoastal Waterway and the Waccamaw River. Since no water from the waterway or the water bodies to which it flows are used to supply drinking water, the proposed system would have no impact on potable water supply.

The proposed system provides much-needed centralization of wastewater treatment in the area. It will eliminate nearly all of the sources of area wastewater pollution which currently pose threats to human health, recreational opportunities, and aquatic animal life, including the area's vast shellfish resources.

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* "Electrical Power Consumption for Municipal Wastewater Treatment," U.S. EPA, EPA-R2-73-281, July 1973.

7.6 COMMUNITY SERVICES AND FACILITIES

During the construction stages of the proposed project, an estimate of the required labor force needed is:

- Phase I, 1977-1978: 550 to 600
- Phase II, 1980-1981: 350 to 400
- Phase III, 1985-1987: 350 to 400

This labor force would be a combination of workers from inside and outside the planning area. Most of the construction workers, however, can be expected to commute to the job sites from the areas around Conway in Horry County and in Georgetown in Georgetown County, outside the planning area.* Few workers are expected to settle in the planning area, but even in the "worst case" situation, where all labor for the project settled in the planning area from other areas, the new workers and their families would be a small addition to the area's permanent population, and the burden on community facilities would be negligible.

During the operation of the proposed system, the following number of employees would be required:

- Phase I : 41
- Phase II : 51
- Phase III: 68**

These employees would cause virtually no burden on the planning area community services.

7.7 USER CHARGES

Phase I of the proposed project will include the implementation of a user charge system for the planning area implemented by the Grand Strand Water and Sewer Authority. The system would utilize two schedules:

- A retail rate and hook-up fee schedule for customers in the areas where the Grand Strand Water and Sewer Authority provides the collection systems and customer service.

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* Waccamaw Regional Planning and Development Council.

** Grand Strand 201 Plan.

- A contract rate and hook-up fee schedule for customers in the incorporated towns in the planning area, in Myrtle Beach Air Force Base and in the Georgetown Water and Sewer District. All systems are responsible for collection costs and customer service in their respective areas.

The rates and hook-up fees paid by retail customers to the Grand Strand Water and Sewer Authority under the user charge system are higher than those paid to the Authority by contract customers. This difference in cost reflects the difference in service provided to the two kinds of users. Retail customers are provided with collection systems, maintenance on collection systems, and customer service by the Grand Strand Water and Sewer Authority. The Authority does not provide these services to its contract customers. Instead, collection systems, maintenance, and customer service are provided by the contract customer's town, the Myrtle Beach Air Force Base, or the Georgetown Water and Sewer Authority.

In order to equitably cover costs during the off-season period, minimum monthly user charges are proposed. Under this user charge system, new users pay their prorated share of the construction costs for the new facilities, and they pay hook-up fees. The proposed user charge system has the following rates and hook-up fees:

- Retail customers:
    - Monthly service charge, $5.55 per ERU*
    - Minimum monthly charge, $3.00 per ERU
    - Metered user, $0.69 per thousand gallons with $3.00 per ERU minimum
    - Hook-up fee, $350 per ERU
- Contract customers:
    - $0.55 per thousand gallons

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* ERU: Equivalent Residential Unit; a unit sewage load of 8000 gallons/month of domestic sewage.

- Minimum monthly charge, $2.50 per ERU
- Hook-up fee, $325 per ERU.

It is anticipated that the user charge system would require periodic re-examination to make adjustments for inflation.

Rates and new hook-up fees have not yet been estimated for either Phase II or Phase III.

The proposed system satisfies the federal funding requirement for equal sharing of system costs among users with the user charge system. The costs for constructing and operating the system are less than the costs for continuation of the existing system and are easily affordable by the area's residents, commercial establishments, and industry.

7.8 OTHER MAJOR PROJECTS IN THE PLANNING AREA

The proposed regional treatment system would have an impact on two major projects in the planning area: solid waste disposal operations and the Corps of Engineers' dredge spoil disposal project.

The regional digested treatment system would produce screened-out solids (grit) and sludge. Most of the grit and sludge produced by the proposed system would be from plants "G" and "A" in Horry Country. Disposal of grit would not be done at the area's golf courses. Only dried sludge would be disposed at golf courses, while grit would require disposal at landfills. The existing Horry County landfill has an expected life of only 2½ to 3 years, and suitable landfill sites are scarce. Adequate disposal of grit generated by the proposed facilities would require careful planning by the Horry County Ecological Commission, the agency charged with solid waste management for the county. While dried sludge disposal on golf courses appears feasible, alternative sludge disposal sites should be determined as a safeguard against any problems which should arise in either the application to golf courses or the marketability of the sludge product. Such alternative sites would also require the careful planning of the Horry County Ecological Commission.

The proposed regional treatment system would benefit the Corps of Engineers' dredged spoil disposal program. It would result in less pollution of bottom sediments dredged from the area's navigable waters. Much of the contamination of the area's bottom sediments can be attributed to wastewater pollution from inadequate wastewater treatment and disposal facilities in the past. The new system would gradually reduce the contamination of the area's waters; and a gradual increase in the quality of dredged sediments, and a decrease in organic and bacterial contamination, can be expected. The benefit takes two forms:

- Increased numbers of acceptable disposal sites for dredged sediments
- Less nuisance associated with existing disposal sites, such as mosquito breeding.

7.9 SENSITIVE MANMADE AREAS

The proposed system would cause some minor impediments to traffic flow on important roads, Route 501 and Route 17, as previously stated.

In Phase I of the project, along a section of Route 17 south of the City of Myrtle Beach, the construction of the major interceptor for treatment plant G would cause a temporary increase in traffic congestion. This is currently the most congested section of Route 17 during the tourist season. The proposed Bryan Drive Extension (Myrtle Beach bypass) is not expected to be completed in time to alleviate any congestion from the proposed project.

During Phase II of the project, the construction of an interceptor to plant G along Route 501 would also cause some temporary traffic congestion. The Bryan Drive Extension would probably be completed by the start of Phase II construction, allowing smoother flow of traffic along this congested portion of Route 501.

CHAPTER 8

SECONDARY EFFECTS OF THE PROPOSED ACTION

Secondary effects are the natural environmental and socioeconomic effects of residential, commercial, and industrial growth induced by the proposed action. In order to determine these secondary effects, one must estimate the magnitude and type of growth attributable solely to the installation of a centralized sewerage system. In other words, one must estimate the growth which will occur if wastes are handled only through septic tanks and package sewage treatment plants over and above the existing capacity of the municipal treatment plants (the no action alternative discussed in Chapter 2) as well as the growth which would be expected with the proposed action. The increment of growth over and above the no action alternative is the growth attributable to the proposed action and becomes the basis for defining and evaluating the secondary effects.

When little or no growth is attributable to a proposed action, secondary effects are, by definition, insignificant. In the case of the Grand Strand regional sewerage system, the estimated growth attributable to the system is essentially the same amount of growth expected to occur under the no action alternative. The unique natural environmental setting and mild climate have, to a great extent, shaped the character of the manmade environment. The Grand Strand is an established resort, and second home area, whose popularity and season have continued to increase during the past fifteen years. The natural amenities which include proximity to ocean beaches, recreational waters, marshes, and parks provide the strong market attraction for tourists, second home buyers, and retirees.

A continuation of the strong market for tourism and high quality resort activity can be expected to support the estimated costs of private package plants and septic tank systems in the absence of municipal sewerage. The Grand Strand area will grow to the projected 1997 population level under either the no action or the proposed action. However, the proportions of the population segments (tourist and permanent residents) may differ slightly and could change in the next twenty years. The analysis of secondary effects focuses on the effects of total growth in either approach to sewage treatment in the Grand Strand area.

This chapter on secondary effects includes the following major topics:

- Assessment of the effects of the no action alternative
  - the patterns and distribution of growth
  - a summary evaluation of the effects of this growth pattern upon the environment
- Assessment of the secondary effects of the proposed action or projected total growth upon the manmade environment
- Assessment of the secondary effects of the proposed action or projected total growth upon the natural environment.

8.1 NO ACTION ALTERNATIVE EFFECTS

The projection of population growth in Chapter 3 assumed that growth would not be constrained by programs designed to attain water quality objectives. The sewage treatment needs of the projected population can be met under no action through the widespread application of package plants and septic tanks. The discussion of the no action alternative effects focuses on those differences which might be expected to occur as a result of a proliferation of septic tanks and package plants throughout the Grand Strand planning area.

8.1.1 Potential Growth

In the past, the unavailability of a centralized wastewater collection and treatment system such as the one proposed in the facilities plan has not impeded growth in the planning area. Septic tanks were installed to serve new housing, and package plants were installed to serve new motels, hotels, and commercial establishments. Future development could be served in similar fashion. There would probably be no impediments to the projected population growth of the area should it be forced to treat wastewater by septic tanks and package plants. However, regulatory agencies, particularly the South Carolina Department of Health and Environmental Control, are well aware of the potential hazards to water quality which would attend a proliferation of septic tanks and package plants. To prohibit septic tank and package plant use would severely impact the local economy and would further retard development of one of the state's prime tourist and recreational areas. Therefore, the agencies involved in regulatory functions, relating to use of septic tanks and package plants, could be expected to adopt standards and procedures which would protect water quality but not preclude new development. For instance, stricter standards for installation and maintenance of septic tanks might be formulated to upgrade tank size, lot size, and leach field, depending upon soil classifications. More sophisticated septic systems might be required to improve effectiveness of operation.

Similar approaches could be applied to package plants. To ensure that water quality standards of the Intracoastal Waterway are met, regulatory agencies have several alternatives including:

- Requiring that all new package plants provide tertiary treatment to produce such effluent quality that great numbers of package plants could discharge to the Waterway
- Requiring that, after the assimilative capacity of the Waterway is reached, proposed discharges be made to water bodies other than the Intracoastal Waterway and its tributaries
- Requiring periodic upgrading of existing package plants discharging into the Waterway to allow new discharges into the Waterway.

This last alternative is considered the least workable due to the management difficulties involved. Periodic upgrading implies that a process of continual water sampling and effluent monitoring of the plants is maintained and that an agency at either the State or local level would have the authority to enforce upgrading through the NPDES permit system or perhaps through some other regulatory program devised under 208 planning. The tracking of several hundred package plants, according to effluent quality, is administratively more complex than the first two alternative approaches, particularly if the maintenance and operation of the plants is not under contract with a municipal or other public sewer and water authority. If maintenance and operation functions are carried out by professional service firms, the monitoring can become more difficult.

Clearly, the objective of both alternative approaches to the regulation of package plants is to ensure adequate treatment of the discharges from new developments that run into the Waterway, streams, and the ocean.

Under the no action alternative, the results of the implementation of the more feasible alternatives can be predicted. The first would result in the use of package plants at all future developments between the Waterway and the ocean, discharging to the Waterway. As a result of the second approach, only some of the new developments between the Waterway and the ocean could discharge to the Waterway. The rest would discharge to the ocean or to streams which flow to the ocean.

The difference in surface water quality protection for the two options is easily assessed. Under both options, the assimilative capacity of the Intracoastal Waterway is not exceeded, and water quality standards are met. Under the second option, the assimilative capacity of the beach waters is only slightly stressed. However, the risk of exceeding water quality standards under the first approach might be greater than that for the second, because of the greater number of package plants which discharge to the Waterway in the first option. The only risk to the exceeding of beach water standards is present in the second option. Regardless of which option might be implemented by the regulatory agencies, the population growth would be sustained at approximately the same level because package plants would provide the only viable alternative to meeting the market demand for new housing and tourism facilities.

8.1.1.1 Cost Impacts of Private Sewage Disposal Systems on Residential Development

If most new developments were forced to use package plants or septic tanks, the question of cost impact on private development would be raised. The cost of septic tanks in the Grand Strand area range from $800 to $1500 per system depending upon site location and soil characteristics. Continued use of septic tanks for single family detached development will be more constrained by decreasing supply of suitable land rather than by cost factors. Since subdivisions with more than forty units are required to put in package plants, septic tank systems are used primarily in single lot development and in small tracts. Stronger regulations are being enacted and promulgated to better control the installation of new systems. However, the water quality problems resulting from septic tank malfunctions are occurring from the systems installed prior to the adoption of state standards and effective regulations for system approval procedures and inspection.

Estimated costs for package plants are shown in Table 8-1. The relative costs per residential unit are indicated for small, medium, and large plants along with an estimate of annual operating and maintenance costs. These cost estimates do not reflect the cost of lines as those costs would be basically the same for a developer whether they were for delivery to the package plant or for a tie-in to the municipal sewer. Additional costs for package plants would occur if an extended outfall line were required, or if several pumping stations were indicated. Line installation costs average $8 to $10 per foot and pumping stations can vary between $10,000 and $15,000 each. Thus, costs for a system on a per unit or per lot basis can run between $500 to $1200, with total costs running an additional $1000 per unit or lot. Total system costs for low density subdivisions, in contrast to those for high rise structures, are considered equal, as the construction of the outfall line for a high rise project may equal the cost of collector lines in a large subdivision. The incremental cost per unit for the package plant system is not considered prohibitive for marketing residential units (both second and primary homes) in the Grand Strand area. The additional cost for the package plant is generally about 1.0 percent of total development cost, on a per unit basis.

8.1.1.2 Residential Development Patterns

The no action alternative may result in slightly different patterns of development. Developers will seek to develop parcels of land within reasonable proximity to streams and discharge points to minimize costs and may try to develop at higher densities to reduce costs of line installation and reduce the per unit capital cost which is passed on to the consumer. Projects in the area between the Waterway and the ocean would likely be designed at higher densities than those projects planned under the proposed action simply to satisfy the developers' objective of recovering the cost of treatment facilities. This same objective may result in higher densities in some projects west of the Waterway for the no action alternative. Densities of projects in this area will be determined by the interaction of a number of factors including:

Table 8-1
Estimated Costs for Package Plants

PLANT CAPACITY	ESTIMATED TURNKEY COSTS ACQUISITION AND INSTALLATION		DEVELOPMENT CONSIDERATIONS			
(gpd)	SECONDARY TREATMENT	TERTIARY TREATMENT[1]	TOTAL PRICE-TT	AVE. DU's SERVED[3]	PRICE PER UNIT-TT	ANNUAL O&M/UNIT[2]
14,000	$2.25/gal.	$3.37/gal.	$ 47,180	40	$1180	$59
50,000	$1.50/gal.	$2.25/gal.	$112,500	155	$ 726	$54
100,000	$1.25/gal.	$1.87/gal.	$187,000	310	$ 603	$54

1 Current engineering estimates assume a 50 percent cost increase over secondary systems

2 Assumed at $ .46 per 1000 gallons-current average O&M cost for existing package plants in Grand Strand area

3 Assumes 3.2 persons per unit and 100 gpd per capita

Source: Grand Strand Sewer and Water Authority
Booz, Allen and Hamilton

- The size of lots for single family homes allowable under septic tank codes

- Land cost and parcel size

- The cost of package wastewater treatment facilities for the project

- The marketability of multifamily dwellings

- Capacity and type of recreational facilities in the project.

Of these factors, the last two would be the same for projects under the no action and proposed action alternatives. Under either action, densities west of the Waterway can be expected to be far less than those east of the Waterway. Most new projects will plan for densities of less than one and up to seven dwelling units per acre. Adequate marketability of most new housing developments will depend upon good access to recreational facilities and may require the development of new ones. Where a developer must develop a new golf course in order to make his project marketable, he will want to plan for higher densities than "single family detached" in order to distribute the costs of development over more units. This would especially apply where lot size restrictions for septic tanks are in effect. Similarly, under the no action alternative developers would seek to distribute the cost of wastewater treatment via package plants over more units. This would possibly result in higher densities than those achieved under the proposed action. The developer would have several alternatives for disposing of the discharge from his project's plant:

- Golf course/open space via spray irrigation
- Waccamaw River
- Intracoastal Waterway.

These alternative discharge points are ranked by increasing cost potential of system implementation.

As a result of the difference in cost to the developer, each alternative might influence planned densities differently. Should the proposed regional facilities not be built, the use of spray irrigation of effluent from package plants on golf courses and rural areas can be considered.

The effluent under this disposal method does not require the same treatment level as for disposal to the Intracoastal Waterway or the Waccamaw River. The space requirements for spray irrigation may range from one to six acres per 10,000 gallons per day of plant capacity. The distance from the plant to the irrigable acreage may require an expensive transmission line, and the ability to spray is limited by weather conditions and recreation levels. This involves additional maintenance costs and control monitoring of the effluent by the local jurisdictions. Cost ranges for spray irrigation for a 1 mgd capacity range from 20 cents to $1.09 per 1000 gallons. One advantage to this disposal method is that the acquisition cost of the irrigable land is eligible for federal funding.

Table 8-2 shows the relatively large population that could be served by spray irrigation on golf courses and other open space - about 28 percent of the projected 1997 population under the no action alternative. The table also presents estimates of the portions of the 1997 population which would be served by municipal plants, package plants with three alternative discharges, and septic tanks. The distribution of population stems from the following assumptions:

- Municipalities will use no federal funds for wastewater treatment projects and will lack adequate local resources to expand existing facilities except for making improvements to meet water quality standards
- Developers will make maximum use of spray irrigation of effluent on golf courses and open space
- All new projects between the Waterway and the ocean will discharge effluent to the Waterway or ocean where spray irrigation on golf courses is not feasible.

Of all the treatment and disposal options presented, package plant treatment with discharge to the Intracoastal Waterway and ocean would best serve the bulk of the expected population.

Table 8-2
Projected Population Growth Served by Municipal Treatment Plants, Septic Tanks and Package Plants for Nine Divisions of the Planning Area, No Action Alternative

DIVISION OF PLANNING AREA	POPULATION 1975	POPULATION 1997					
		TOTAL FOR DIVISION	PORTION OF POPULATION SERVED BY TYPE OF WASTEWATER TREATMENT				
			MUNIC. PLANTS	PACKAGE PLANTS SPRAY IRRIGATION GOLF COURSES/OPEN SPACE	PACKAGE PLANTS DISCHARGE TO OCEAN/WATERWAY	PACKAGE PLANTS DISCHARGE TO WACCAMAW	SEPTIC TANKS
Georgetown to Brookgreen	14,455	52,723	4,745	14,762	26,889	3,163	3,164
Murrell's Inlet to Air Base	32,940	67,455	4,722	14,840	29,006	14,165	4,722
Air Base	3,700	3,500	-	3,500	-	-	-
Myrtle Beach	94,200	144,173	90,829	12,976	40,368	-	-
No. Myrtle Beach	78,395	136,511	21,842	30,032	80,542	-	4,095
Little River	3,280	15,518	-	15,518	-	-	-
Buist Tract Area	964	38,174		38,174	-	-	-
Red Hill, Nixonville, Wampee, Nixon's Crossroads	2,680	7,798	-	-	-	-	7,798
Area South of Rt. 501 and West of Waterway	2,340	32,976	-	11,211	7,255	7,255	7,255
TOTALS	232,954	498,828	122,138	141,013	184,060	24,583	27,034

8.1.1.3 Population Growth

This section explains why growth in the planning area is expected to be about the same for the proposed action and the no action alternative. The following assumptions underlie the no action alternative:

- No regionalization of wastewater treatment facilities would occur
- Expansion of the Garden City treatment plant would bring its capacity to 0.5 mgd as planned
- Utilization of the other municipal plants would be to maximum existing capacity or to capacity of currently planned expansions.

Total flow to municipal plants would increase from the 1974 level of 9.4 mgd to 12.6 mgd in 1997 under the above assumptions. The remainder of the regional wastewater would be treated by a combination of:

- Package plants using spray irrigation to golf courses and other open spaces
- Package plants discharging to the Waccamaw River, the Intracoastal Waterway and the Atlantic Ocean
- Septic tanks.

In contrast, the proposed action would treat regional flows of three plants and utilize only three existing package plants and septic tanks located in the more remote parts of the planning area.

The no action alternative would probably have some effect on the distribution of population by employment sectors. Without municipal sewers, the area is much less attractive to industry, particularly manufacturing, and to regional commercial facilities. Industires discharging into municipal sewers need only comply with applicable pretreatment standards or ordinance in force. Without municipal sewers, each industry would have to design its own package treatment facility in accordance with the NPDES process within the State of South Carolina. The process can be time consuming, expensive, and may result in more restrictive permit conditions. Hence, the lack of municipal sewers is a significant deterrent to a local jurisdiction's ability to attract more industry into the area. The attraction of industry is viewed as desirable to provide more diversity in the economy, more stable year round employment, higher wages, and lessening of the tax burden on homeowners for public services and facilities. The tax burden is always more distorted in tourist economy-based communities because the facilities and services frequently must be sized and oriented to a peak population of users, a large proportion of whom are only indirect taxpayers.

The tourist and transient populations indirectly support the cost of the infrastructure investments through rental fee structures, sales tax revenues, and other expenditures made in the Grand Strand area. However, if tourism levels decrease because of economic recession, effects of natural disasters, etc., the basic burden of financing facilities and services must be borne by the permanent population. The reduced level of industrial development would be expected to have a similar effect upon primary home development.

The market for new residential units will be much greater than that for industrial and commercial space and is, therefore, the focus of this analysis. The market will consist primarily of two types of development: high density beach-oriented hotel, motel, and condominium units serving the second home and tourist market; and low to medium density recreation-oriented single family, townhouse, and multifamily units to serve the primary home market. Retirees are served in both markets depending upon their economic and personal lifestyles. The latter is expected to include planned unit developments, with such amenities as golf courses, tennis courts, marinas, manmade lakes, and landscaped open space. In order to reduce per unit cost increases due to sewage disposal systems, the individual developments may tend to be larger to maintain marketability.

Developers can be expected to provide the needed sewage treatment capacity for beach-oriented high density development in two ways. First, groups of developers could pool resources and construct treatment plants which would serve two or more structures. This strategy was used in North Myrtle Beach to build the so-called Environs Line, and DHEC would be expected to promote the strategy in the future, should a regional treatment system not be built. The sharing of treatment facilities would result in great savings in land consumed by plants and rights of way for collection and discharge lines, as well as in economies of scale in treatment works. These results translate into cost savings in development, as well as into greater wastewater treatment reliability. Still, a great number of package plants would be built near the high density developments. Table 8-3 shows twelve divisions for the planning area which have distinct, separable prospects for future development.

The second method by which developers could provide adequate sewer capacity in these beach-front areas is the utilization of existing and proposed golf courses for spray irrigation. Use of this method would result in no direct discharges to waterways. This method is currently practiced in three communitites in the planning area. Most existing and future golf course sites along the beach are located in Myrtle Beach and North Myrtle Beach, division 4 and 5 in Figure 3.5. In these areas, more than four million gallons of sewage effluent could potentially be applied to golf courses and open spaces.* Such capacity could serve 40,000 people, using 100 gallons per day per person, as an average flow rate. Thus, spray irrigation could take the place of some discharges to the ocean and the Waterway. Since the vast majority of new development in divisions 2, 3, 4, and 5 will be in high density units, which cannot be served by septic tanks, few new septic tanks would be added in those areas.

Developers could use similar approaches to sewering land for low and medium density communities in the remainder of the planning area. For example, many acres of land in divisions 6, 7, 9, 10, and 12 would probably be developed as golf courses in new communities, and could be used for spray irrigation. In fact, these acreages theoretically could support a total of about nine million gallons of effluent applied to the land per day (this would service about 90,000 people using an average per capita flow rate of 100 gallons per day). Thus, these irrigable acreages would be extremely valuable to the developer in sewering new land, and would probably be used to the fullest extent possible for land application of treated effluent. Developers could also pool resources and build treatment systems which would serve two or more communities. Such systems could use spray irrigation or could discharge to streams. In either case, the results would include the creation of large acreage open space/recreational resource areas, greater reliability in effluent quality, and economies of scale.

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* Based on an effluent application rate of 1.5 inches per week per acre.

Table 8-3
Population Distribution among Twelve Divisions of the Planning Area

DIVISION OF PLANNING AREA*	POPULATION			
	PERMANENT		SEASONAL PEAK**	
	1974	1997	1974	1997
1. North Inlet to Pawley's Island	154	2,385	1,661	15,216
2. Pawley's Island to Murrell's Inlet	625	1,042	11,506	19,964
3. Murrell's Inlet to Myrtle Beach	4,016	4,210	51,644	62,849
4. Myrtle Beach	12,250	15,681	84,832	122,161
5. North Myrtle Beach	4,120	7,400	87,592	141,640
6. Rt. 17 Bridge at Georgetown to Brookgreen	774	3,280	1,443	17,469
7. Brookgreen to Air Base	3,140	10,352	4,526	26,458
8. Air Base	3,481	3,000	3,680	3,500
9. Area South of Rt. 501 and West of Waterway	1,837	20,840	2,475	32,951
10. Buist Tract North of Rt. 501	200	20,481	250	32,790
11. Redhill, Nixonville, Wampee, Nixon's Crossroads	1,942	5,826	2,638	7,914
12. Little River	2,345	8,678	3,462	15,506
TOTALS	54,884	103,175	255,704	498,418

* Note: These divisions are shown on Figure 8

** Source: Booz, Allen & Hamilton Inc.

Package plant discharges to the Intracoastal Waterway could be circumvented by developers, if necessary, by selecting appropriate points along the Waccamaw River for discharge. In fact, nearly all new development in divisions 6, 7, 9, 10, 11, and 12 could probably route discharge lines to the River, in lieu of the Waterway, if necessary.

Septic tanks would be installed to handle wastewater in area or projects where hook up to a package plant system would be uneconomical, and where single family lot sizes are large enough to support a septic tank drainage field according to whatever regulations on field size pertain at the time. Under the no action alternative, septic tanks would probably be added, particularly in divisions 7, 9, 10, and 11. However, spray irrigation is also likely to be widely practiced in these divisions, acting as a substantial check on the proliferation of septic tanks. The decreasing amount of land suitable for septic tank systems combined with stricter regulations regarding standards and installation will act to constrain the application of septic tanks for sewage disposal.

Developers could be expected to have adequate enough opportunities to sewer land and place septic tanks in the no action case to meet the demand for new space. The supply of buildable land, and the mix of improvements that it could support in the no action case, would be about the same as under the proposed action. The costs per unit are not signigicant enough to deter private market forces.

8.1.1.4 Density and Land Use

The effects of the no action alternative have already been discussed as they relate to potential residential and commercial/industrial development patterns. There are no significant changes in density or land use patterns which would be expected under the no action alternative. However, the development process and the local jurisdiction's ability to manage growth under the no action alternative would be expected to become more complex and diffuse over the years. Interlocal cooperation on development matters which necessarily affect water quality would have to be improved. Land use planning and implementation through zoning and sewer ordinances would become much more controversial and critical to reaching and maintaining areawide water quality objectives.

The most significant growth inducing projects in the planning area are transportation improvements. The area will depend heavily on the development of the improvements described in Chapter 3 for its future growth.

Both the no action alternative and the proposed action would result in the same basic changes to existing land use and the existing transportation system. These include:

- Intense, high density beach front development in areas either currently undeveloped or used as campsites, fishing piers, and single family residences
- Integral golf course - residential community development with densities of less than one dwelling unit per acre to 22 units per acre in areas currently used as commercial forest, commercial forest-game management area, and agricultural land
- Displacement of some campsite areas away from beach front or near beach to inland areas as the former sites are converted to more intense use as hotels, motels, and condominiums
- Loss of most acreage now used for game management to low density residential use, especially in the Buist Tract
- Development of the corridor between Myrtle Beach and Conway with limited commercial and industrial uses on lands currently used as commercial forest
- Construction of a limited access highway to Myrtle Beach from Florence, South Carolina, which would bypass Conway to the north, cross the Waccamaw River in several places, cross Route 90 near Grahamville, cut through the Buist Tract, cross the Intracoastal Waterway, and connect to Routes 17 and 317 north of Myrtle Beach.

The changes are consistent with the goals of the area to grow in tourist capacity, to lengthen the tourist season, and to broaden the area's economic base.

8.1.2 Community Services and Facilities

Population levels and development patterns affect both the amounts of community services needed and the location of community facilities. Since population levels will be similar under both the proposed action and no action alternative, the extent of the demand for facilities and services also will be similar in both cases. A more detailed discussion of the services and facilities needed for the projected population is contained in 8.2.2.

Since development patterns under the no action alternative will vary slightly from those projected under the proposed services, location of community service facilities may also vary. Under the no action alternative, parcels designated "low-density," "high-density" under the proposed action will retain those designations, though the actual density or distribution on a tract may differ. This difference in density may affect decisions regarding location of services. The higher and more evenly distributed the density, the easier it is to determine a location for community facilities which will service the greatest number of people. Since the no action alternative may result in less uniform density distribution, location of facilities may differ from that under the proposed action. In addition, the no action alternative is likely to constrain industrial growth. The result may be a higher proportion of transients who contribute only indirectly to the financial support of community services. Moreover, the character and level of community services, particularly in terms of amount of needed equipment and personnel, will differ depending on the ratio of transient to permanent residents.

The major community service area requiring capital investments will be schools, roads, fire, police, and administrative facilities. County and community government agencies will have to carefully monitor the actual amount and patterns of growth in order to determine the required amount of capital investment and distribution among services. For example, if the no action alternative constrains industrial growth, thereby attracting tourists and retirees rather than families, communities may find it necessary to invest in improved hospital and specialized medical care, special counselling, transportation, and recreation programs and facilities. Investment in schools will be less important.

The tax base to support these services and facilities will be affected by:

- The degree of industrial expansion
- The growth in the median income and assessed valuation of real property
- The number and kind of grants for which the communities are eligible from state and federal government programs.

The major effect of the no action alternative is that the tax burden is likely to be greater upon the permanent population than under the proposed action, because of the constraints placed upon the area's ability to attract industry and to expand their non-tourism related employment base.

8.1.3 Sensitive Natural and Manmade Environmental Areas

Several natural areas, as well as manmade sites of historic, cultural, or archeological significance, are sensitive to potential development of adjacent areas. Specific examples of sensitive areas could include plantations, cemeteries, experimental farms, digs, ruins, marshlands, and wetlands among others.

For example, sensitive natural areas in the Grand Strand include North Inlet, Murrell's Inlet, and Little River Inlet. All are estuaries which are important for their biological productivity. They are particularly sensitive to water pollution resulting from runoff and treated sanitary waste discharges.

Recreational areas and resources need continued protection from overuse and deterioration, particularly those resources involving water bodies. Under the no action alternative, the effects of growth on water quality are much more serious than under the proposed action. This is due to the overall lower level of reliability and effluent quality obtained by several hundred package plants as opposed to a regional centralized plant. The proliferation of outfalls and discharges to the streams, Waterway, and ocean would make monitoring much more costly and inefficient.

Existing administrative and regulatory controls appear to be adequate to protect North Inlet, in Georgetown County, from potential impacts from nearby development. Added protection would result from the planned dedication of much of the surrounding land as a park. Murrell's Inlet, in Horry County, is protected by regulatory controls only - water quality criteria and a waste discharge permit system. Thus, it may be more affected by runoff as the area develops than if some form of administrative land use control - such as zoning - were in effect. Little River Inlet, also in Horry County, is subject to the same control as Murrell's Inlet. Therefore, it also could potentially be affected by more runoff than if administrative land use controls applied. Here too, added protection would result if plans for dedication of surrounding areas as parkland were carried out.

All of these sensitive natural areas would be much more susceptible to water pollution under the no action alternative. This is because of the greater environmental risks associated with the use of septic tanks and package plants, rather than a regional wastewater treatment system, under the proposed action. Section 8.2 contains a more detailed discussion of the secondary effects upon the natural environmental elements due to total population growth, which is approximately the same under either action.

New development in the planning area would have effects on the manmade environment as well. For example, with the exception of two archeological sites several known sites of archeological interest are areas which can reasonably be expected to undergo development. These sites have already been explored, but it is expected that protection of any heretofore undiscovered finds will be made a provision of any site plans approved and building permits issued in those areas. This would pertain in either the no action or proposed action alternative. Measures to lessen the adverse effects of land preparation on these resources are described in Chapter 9. There are no significant impacts to historic sites or cultural resources expected under the no action alternative.

The projected high density projects along the beach may detract from the aesthetic quality of the resort as the area grows. Some overbuilding might ordinarily be expected in such a popular resort as the Grand Strand; but for the foreseeable future, developers and lenders can be expected to carefully evaluate the marketability and profitability of proposed projects. The results should provide a check against overbuilding. Natural market forces should also provide a check in that the popularity and marketability of resort areas frequently stabilizes at certain densities. These densities are almost impossible to predict and vary according to factors of natural setting, climate, character of development, and profiles of the consumers. One important factor in the Grand Strand, and other water-oriented resort areas, is that if water quality substantially deteriorates and recreation activities are affected (e.g. boating, swimming, beaching) the negative impact to the Grand Strand economy could be substantial.

Many factors will affect the quality of future development. Much of the planning area is subject to no zoning, no subdivision regulations, and no standards for minimum lot size geared to soil conditions. However, much of the projected development will occur near the beach where the incorporated towns and Georgetown County do have zoning. Georgetown County has subdivision regulations as well. Still, most of the land in the planning area is undeveloped and subject to no development controls except for regulation of wastewater discharge. At the same time, most of the undeveloped land is owned by relatively few persons or corporations, most of whom also engage in land development. These owner-developers have, in the past, exerted great control over the character of new development, partly to protect the value of their remaining land. holdings. A result has been high quality development for the most part. Another result has been planned development of land in relatively large tracts under the control of a single developer. This has resulted in orderly, more environmentally sound growth. The orientation of the planning area toward recreation requires that new communities be planned around golf, tennis, or water sports facilities, in order to be marketable. Scattered lot development has not played, and will not in the future play, a significant role in new development.

Some community facilities may be considered sensitive to the construction impacts of new development including schools, hospitals, nursing homes, and libraries. However, the effects are generally temporary and can be mitigated by careful measures applied during construction.

Farming and agricultural operations are generally negatively affected by increased development due to the rising valuation of land which makes farming increasingly uneconomic. Farming within the planning region is not a substantial sector of the local economy and the conversion of agricultural lands to other uses would occur regardless of the approach to sewage treatment. Under the no action alternative the value of the land might increase at a slower rate, due to the dependence upon septic tanks or package plants, which will ultimately reduce the compensation to the farmer or rural landowner.

8.2 SECONDARY EFFECTS OF CENTRALIZED SEWAGE TREATMENT ON THE MANMADE ENVIRONMENT

The total population growth projected for the Grand Strand is expected to occur regardless of the approach taken to the provision of sewage treatment. Consequently, the analysis of secondary effects of the proposed action on the manmade environment are similar to the discussion under the no action alternative. However, the analysis of effects of total growth on community services and facilities are explored in greater detail below.

8.2.1 Potential Growth

With municipal sewers available, the Grand Strand area would be able to compete more strongly for clean industry and commercial development to serve both its permanent and tourist populations. The attraction of clean industry, which is more compatible with tourism and resort development, would provide a more diversified economic base for the area with generally higher wages, broader employment opportunities for men and women, and a labor force less vulnerable to seasonal and economic fluctuations. Thus, the proportion of permanent population might be expected to increase under the proposed action. The larger permanent population would probably correspond to a slightly smaller proportion of tourist and transient population as more acreage was developed for primary residences—typically, single family low use developments. The same number of new units would be developed, but their market orientation would include both primary and second home emphasis.

The conversion of second home developments to primary neighborhoods is a common phenomenon in the sunbelt. It gives rise to the importance of growth management and capital improvements planning which is responsive to the potential changes in a community's or region's population. As developments convert to primary neighborhoods, the need for community services and facilities increases significantly. To some degree, the types of services and facilities will depend upon the household characteristics of the primary residents—size, age, composition, income, and other factors.

8.2.1.1 Development Patterns

The development patterns should be very similar to those expected under the no action alternative. Higher density, tourist-related facilities will be concentrated between the coast and the Waterway with low density, residential and commercial development occurring inland. The costs of development are not significantly different for municipal sewers than for package plants and septic tanks. The tie-in or tap-on fees should be commensurate with the service costs and loadings. Developers would be expected to install the collection lines tying into municipal sewers or a package plant.

The determination of costs for capital installation and maintenance for the no action alternative assumes that all new population growth will be served by package plants offering tertiary treatment and by septic tanks. These population figures are shown in Table 8-2. The growth of households on septic tanks was assumed to be on an equal annual basis:

27,034 people ÷ 3.4 persons per household = 7951 households
over 20 years = 397.5 septic systems per year

The resulting capital costs for the three phases under the proposed action are as follows:

Phase 1	1987.5	units @ $1000	=	$1,987,500
Phase 2	1987.5	units @ $1000	=	1,987,500
Phase 3	3975	units @ $1000	=	3,975,000
TOTAL	7951			$7,950,000

There are no reliable estimates of maintenance expenses for septic tank systems; therefore, none have been included in the subsequent analysis. To determine costs for treatment via package plants, the population increases by category and by phase were adjusted to account for those served by septic tanks and the subsequent application of the waste production values to determine gallons per day for treatment. Tables 8-4 and 8-5 reflect these procedures.

Table 8-4
Grand Strand Population Growth by Category

PROPOSED PLAN PHASES	PERMANENT RESIDENT	OVERNIGHT TRANSIENT	DAY VISITOR	TOTAL
1-1982	19,193	93,009	9,850	122,052
2-1987	22,000	47,896	6,120	76,016
3-1997	33,175	23,077	15,280	71,532

Source: Booz, Allen and Hamilton

Table 8-5
Equivalent GPCD (ADF) of Population Growth

PROPOSED PLAN PHASES	PERMANENT RESIDENT[1] (100)	OVERNIGHT TRANSIENT (50)	DAY VISITOR (25)	TOTAL
1-1982	1,243,600	4,650,450	246,250	6,140,300
2-1987	1,524,300	2,394,800	153,000	4,072,100
3-1997	1,966,000	1,153,850	382,000	3,501,850

Source: Booz, Allen and Hamilton

[1] These figures have been adjusted to reflect only the population on package plants; populations on septic tanks have been removed for separate estimating.

Table 8-6 shows the estimated capital and maintenance costs for the package plant treatment and septic tank systems under the no action alternative. The maintenance costs are only rough estimates since the occupancy and gallons treated fluctuate during the year. The annual maintenance cost was adjusted by a factor of 66 percent to reflect lower than peak population and capacity treatment levels on an annual basis. The 66 percent factor is not based on any document but rather on a lengthening tourist season (to eight months of the year).

The comparison of the no action and proposed action costs are shown in Table 8-7. The costs for the proposed action were converted to 1976 dollars to compare with the no action cost estimates. The national CPI figures for the month of April 1974 and 1976 were used to make this conversion.*

The resulting figures indicate that the capital expenditures for a centralized sewage treatment system are significantly higher than for a system of package plants under both public and private ownership. The O&M costs shown are approximately the same for either approach, although the O&M costs under the no action alternative do not reflect O&M costs for existing municipal plants and package systems. Hence, the overall O&M costs under no action could be expected to be substantially higher than with the proposed action which does reflect existing municipal plant O&M costs in Table 8-7.

Another important cost factor to consider is the source of financing for the two alternatives. Under no action, the majority of costs for package systems would be borne by private developers and their consumers, and by the local sewer and water authorities and jurisdictions. For the most part, the systems would have to be financed by high cost commercial loans and partial federal grants for eligible aspects of the systems such as spray irrigation. The public systems could be financed through local bond issues. The centralized system of the proposed action would be eligible for 75 percent federal funding, which brings the local share of capital costs to approximately $13 million in 1976 dollars. State assistance grants are available to cover portions of the local share. The state funds are repaid from revenues collected as user charges or through a special property tax.

It would be difficult to determine the "local share" under the no action alternative. The direct local share would involve the costs of package plants needed to serve all new

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* $\frac{168.2}{143.9} = 1.1689$

Table 8-6

Estimated Costs of Providing Sewage Treatment Under the No Action Alternative in 1976 Dollars

PROPOSED PLAN PHASE	TOTAL GALLONS TREATED	TURNKEY COST ESTIMATES[1] ($)	ANNUAL MAINTENANCE COSTS[2] ($)	SEPTIC TANK CAPITAL COSTS ($)	SEPTIC TANK O&M[3]	TOTAL CAPITAL COSTS ($)
1-1982	6,140,300	15,350,750	680,302	1,987,500	-	17,338,250
2-1987	4,072,100	10,180,250	451,206	1,987,500	-	12,167,750
3-1997	3,501,850	8,754,625	970,104	3,975,000	-	12,729,625
TOTAL	13,714,250	34,285,625	2,101,612	7,950,000	-	42,235,625

[1] $2.50 per gallon cost is the average tertiary treatment cost taken from Table 8-1.

[2] 46¢ per 1000 gallons, see Table 8-1; an annual occupancy figure of 66 percent was used to reflect seasonality.

[3] No reliable figures are available.

Table 8-7
Comparison of No Action and Proposed Action Capital and Maintenance Costs in 1976 Dollars

PHASES	NO ACTION		PROPOSED ACTION	
	CAPITAL[1] ($)	O&M[2] ($)	CAPITAL[3] ($)	O&M[2] ($)
PHASE 1	17,338,250	680,302	27,157,000	1,191,000
PHASE 2	12,167,750	1,131,508	17,098,000	1,714,000
PHASE 3	12,729,625	2,101,612	7,709,000	2,187,000
TOTAL	42,235,625	2,101,612	51,964,000	2,187,000

[1] The capital costs do not reflect any costs for upgrading existing treatment plants or collection systems.

[2] The O&M costs are cumulative by phase.

[3] These capital costs include estimates for upgrading of existing facilities identified under the proposed action.

public facilities such as recreation facilities, schools, libraries, and public office buildings. However, the direct share of package plant costs in residential developments would also be passed on to the consumer, the homeowner, as would be higher maintenance costs for the many plants serving his place of employment, his children's schools, his recreational and cultural facilities, and his shopping centers. These costs would be reflected in higher property taxes, higher user fees, and possible increases in sales tax and other sources of local revenues.

8.2.1.2 Density and Land Use

The proposed action with centralized sewage could provide the local jurisdictions with a potentially significant planning tool to manage the expected population growth and new development. If municipal sewers are available, there are no lot size restrictions for single family residential development under the existing regulations. Thus, greater land use planning and design flexibility are achievable. This would allow cluster development, townhouse development, and zero lot line development. The efficiencies achieved by such developments could ultimately reduce stormwater runoff and the degree of major alterations and disturbances to the land because of paving, grading, and other development activities.

There are no major changes to land use and density (other than those identified under the no action alternative) that will occur because of total growth and the conversion of undeveloped acreage to primarily residential and recreational uses. Figures 3-10 and 3-11 display existing and proposed land uses given the centralized sewage treatment facilities. These changes and trends can be summarized as follows:

- The Waccamaw Neck forested areas can be expected to develop with low density residential uses combined with extensive recreational and park-like development

- The forested areas adjacent to Brookgreen Gardens should continue to develop primarily with low density residential, park and recreational uses

- The Gardens area should be basically retained with additional park and golf course development; low density residential use should continue north of Brookgreen Gardens on both sides of Route 17

- Medium density residential uses should continue along both sides of Route 17 from Pawleys through the beach communities

- Lower density residential uses can be expected to occur in the undeveloped areas adjacent to Route 544 with the possible encroachment upon some agricultural areas

- Park development should occur along stretches of the Intracoastal Waterway currently undeveloped or containing some low density housing development

- Industrial development will continue to concentrate to the west of the Waterway within proximity of the Jetport and Myrtle Beach Air Force Base

- Low density residential uses should emerge on the inland areas which are currently shown as forest on both sides of Route 501; a commercial corridor adjacent to 501 is expected to serve both primary neighborhoods and incoming tourist traffic

- Park and recreational areas are planned to be scattered throughout the inland areas to preserve open space and some forested lands

- High density residential and tourist facilities will probably continue to be clustered along the beach strips north of Myrtle Beach through several jurisdictions to Cherry Grove Beach, which is planned to retain low and medium density development

- Institutional and commercial uses will generally be retained and expanded along the major access routes to facilitate traffic flow.

The management of growth and the development process followed over the next 25 years will determine to a great extent the amount of disruption to the manmade environment. Local jurisdictions should encourage consideration of potential environmental impacts in any public or private sector project planning efforts. The placement of public facilities should carefully reflect the access needs of the intended service population. Land planning should be sensitive to the preservation or replacement of landscaping and should seek to minimize unnecessary paving—both to minimize stormwater runoff and to create an aesthetically pleasing environment. Control over construction activities is also important to mitigate the negative effects of congestion, noise, sediment and soil erosion, dust, and glare from construction site lighting. Development ordinances and regulations concerning construction activities should be carefully reviewed by the appropriate jurisdictions to safeguard the manmade as well as the natural environment from the potentially negative effects of the development and construction processes. Where these controls are lacking or need strengthening, the appropriate steps should be initiated. For instance, the control over construction and development in Horry County is much less developed than in Georgetown because of the absence of county-wide zoning and land use controls.

8.2.2 Community Services and Facilities

The population growth projected for the planning area will require a significant increase in community services and facilities. County and community government agencies can evaluate the types and amounts of additional services by evaluating the availability, adequacy, and accessibility of those services. Since widely accepted standards on the appropriate level of services for communities of different sizes do not exist, each community will have to make its own evaluation. For example, in evaluating availability, adequacy, and accessibility of police service, communities should survey the population level, density, density distribution and development patterns, existing crime rate, age distribution, and transience.

The WRPDC's recent survey of fire services shows that such services are unavailable and inaccessible to large segments of the population. Principal contributing factors are the large amounts of unincorporated, undeveloped, or very low density land. The proposed action is likely to stimulate higher density development than the no action alternative. Although this new development will strain existing inadequate services, it will also alleviate present difficulties in providing those services.

The balanced development patterns, which the proposed central sewerage system will encourage, are likely to produce a need for capital investment in a wide variety of services. As 8.1.2 noted, under the no action alternative, communities may have to concentrate on providing specialized services for the larger proportion of transients and retirees. At the same time, these services will be more difficult to finance. The simultaneous residential/family, industrial, and tourist growth which will occur with a central sewer system will result in a greater need for schools and libraries than under the no action alternative. The planning area still will require specialized services for the increasing population of retirees and tourists. However, financing of increased services and facilities will be easier because of a broader permanent tax base, higher median income, and fewer seasonal variations. Location of services also will be easier because of a more controlled distribution of people throughout the planning area.

8.2.3 Sensitive Environmental Areas

Sensitive areas in the manmade environment include those archeological, historical, and recreational sites and facilities that could be damaged by the effects of growth and increased land development. The effects could vary and range in character from the deterioration of facilities because of overuse and inadequate maintenance to the deterioration in the perceived quality of life in the Grand Strand from the overcrowding of facilities or the decline in the aesthetic character of new development. This section discusses the significant effects on archeological, historical, and recreational sites and facilities which could occur from the growth and development projected for the Grand Strand.

8.2.3.1 Archeological Sites

The known archeological resources, listed in Appendix E, would be in potential danger from future building activity near their locations. In Horry County, all but two known archeological sites, H14 and H15, are in areas currently subject to development planning. These sites have already been explored and could most likely be explored further, if warranted, before irreversible construction damage occurs.

Site H15, a private home with Confederate earthworks on the property is in a section of the Little River area which might be used for parkland or a golf course. If either use of the land is made, the historical site could be preserved.

In Georgetown County, the majority of the known archeological sites are in remote areas with few access routes. These sites include G3, G7, G15, G16, and G17. They are safe from development. Sites G1, G4, G14, and G25 would be subject to development, but adequate time is available before development for further exploration should it be warranted. There may be other archeological remains in the planning area; these may be subject to damage during land preparation for new development. Measures to lessen potential danger to such remains are given in Chapter 10.

8.2.3.2 Historical Sites

None of the area's historical sites would be endangered by facilities, public or private, constructed to serve projected population growth.

8.2.3.3 Recreational Facilities

Recreational facilities should generally grow apace with growth of permanent residents and tourists. Golf will continue to be the dominant recreational activity, and tennis will continue to attract more tourists during the next 20 years. Golf and tennis club privileges will continue to be offered to tourists by motels and hotels. Oceanfront campsites will decline in number as the property on which they are located becomes more economically valuable for other uses such as condominiums, motels, and hotels. The development of new campsites may require the construction of recreational facilities such as manmade lakes and tennis courts, or provide use privileges at other public and private facilities. State and municipal park systems may also provide campsites. The park systems will improve the quality of their existing facilities and expand as their budgets allow. The standards followed for recreational facilities depend on the character and class of the resort project. The more exclusive developments will strive to have the lowest units or guests-to-facilities ratios. The southeastern coastal developments generally plan no more than 1000 units per 18-hole golf course and are in the process of reducing the ratios for tennis courts. Indoor tennis clubs vary from one double court to 150-250 members or guests. Both indoor and outdoor courts are now desirable to extend the season for tourists via special tennis weeks all year round.

Population to facilities ratios for permanent residents are generally much higher and are based on the community's changing interests, school facilities, and the capital improvements budget priorities.

8.3 SECONDARY EFFECTS OF CENTRALIZED SEWAGE TREATMENT ON THE NATURAL ENVIRONMENT

Since the total population growth projected for the Grand Strand is expected to occur regardless of the approach taken to the provision of sewage treatment, the impacts discussed here would be similar to those which would occur if the no action alternative was chosen.

8.3.1 Surface Water

Land development within a given region will generally increase in proportion to the region's population growth. As natural land areas are developed into residences, commercial establishments, and industrial complexes, the amount of land surface area impervious to water will increase. A major environmental concern is water runoff into the surface water systems within the region as a result of this urbanization. Urban runoff contains a variety of pollutants which will significantly affect surface water quality. These pollutants may be a combination of fertilizers, oils, leachates, pesticides and fungicides, silt, nonsettleable solid waste, organic solvents or additives, and other organic or inorganic materials.

The Grand Strand region's population is expected to grow at an above-average rate; therefore, urban runoff will become an environmental issue of greater significance. To provide a "worst case" perspective, the amount of urban runoff for the Grand Strand region was estimated. Extreme rainfall data were obtained from the National Weather Bureau Service representing 50-year/24-hour and 100-year/24-hour storm conditions. Runoff values were calculated under these extreme conditions for both present land use patterns and 1997 projected land use patterns for evaluating the effects of induced development. The method used for this calculation is reported in the U.S. Soil Conservation Service's Technical Report No. 55, "Urban Hydrology for Small Watersheds," January 1975.

Based on present land use patterns, the amount of runoff for a 50-year/24-hour storm event is approximately 127,000 acre-feet (41 billion gallons), and for a 100-year 24-hour storm event, the runoff is approximately 146,000 acre-feet (48 billion gallons). These values are based on present land use estimates for the following land use categories: 232,000 acres for undeveloped (forestlands); 9,300 acres for developed (residential, commercial, and industrial); and 2,500 acres for semideveloped (parks, golf courses, etc.).

The calculated runoff volume during a 50-year 24-hour storm event is approximately 151,000 acre-feet (49 billion gallons) for the 1997 projected land use patterns. For the 100-year/27-hour storm event, the calculated runoff volume is approximately 171,000 acre-feet (56 billion gallons). The 1997 projected land use areas used in the calculation are summarized as follows: 97,600 acres for semideveloped; 146,000 acres for developed; and 0 acres for undeveloped.

Regardless of the storm condition selected for evaluation, the additional runoff induced by urbanization is approximately 25,000 acre-feet or 8 billion gallons. If projected land use patterns are realized within the planning region, all runoff will have to be conveyed to small streams and major rivers by storm sewers. Without proper planning, substantial flooding may result from the high volume of water discharged to these streams and rivers. Urbanization may also cause a reduction in low flow rates of small streams. This reduction is the result of decreasing the recharge capacity of the surrounding land which will, in turn, reduce the capacity of the small streams for assimilating wastes.

With respect to the proposed project, the Grand Strand wastewater facilities are not expected to induce further growth within the region. Therefore, the effects of urban runoff on the quality of the surrounding surface waters are not expected to be altered.

8.3.2 Groundwater

A major impact of induced growth on groundwater is the reduction of recharge areas to the water table aquifer. The developed areas within the Grand Strand region will most likely use the Pee Dee-Black Creek aquifer as their potable water supply. Thus, the impact on the recharge areas of the water table aquifer is expected to be only local and not result in water shortages. Outlying rural areas also depend on the water table aquifer as a water supply, but recharge reduction will not have a significant impact on the urbanized or developed areas.

The Pee Dee-Black Creek aquifer is used extensively as a potable water source. Heavy pumping activities have resulted in a lowering of the aquifer's recharge potential. Although USGS reports have indicated that the water supply is adequate for projected growth, the location of wells, and the supply and demand aspect, must be carefully monitored to prevent water shortages. Since the proposed wastewater treatment facilities for the Grand Strand region are not expected to induce further growth, the projected demand for potable water will remain the same.

8.3.3 Water-Land Interface Areas

Growth is possible within the Grand Strand region in water-land interface areas which are biologically productive. These areas include undeveloped floodplains, marshes, estuaries, and beaches which are unsuitable for urban development; however, irreversible damage may occur if filling, grading, or other encroachments are allowed. This irreversible damage may be direct, because of filling and development, or indirect, because of sedimentation or siltation resulting from construction and/or urban runoff. With proper land use controls or mitigative measures (e.g., zoning ordinances, construction standards or procedures, or conservation methods), the potential adverse impacts of growth on the water-land interface areas can be minimized. The measures used to reduce these impacts depend on the availability of other waterland interface areas nearby for spawning, feeding, or nesting purposes.

8.3.4 Aquatic Life

Urban runoff during a "worst case" rainfall is expected to have a significant effect on the aquatic life of the surface water systems in the Grand Strand region. However, the primary effects are expected to be changes in the salinity in estuarine systems and changes in the turbidity in both fresh water and estuarine systems. These effects are expected to be relatively short-term, and not severe or adverse. High runoff flows into an estuarine system will change the salinity level rapidly, therefore affecting the productivity and diversity of the system's aquatic life.

However, the salinity level will recover quickly because of the continuous mixing and tidal movement characteristic of estuaries. The recovery period for the aquatic life is usually short but can range from several weeks to several years, depending on the diversity of the species and the species' sensitivity to salinity changes. For example, most finfish are diverse and will usually have recovery periods of several weeks or less while shellfish are not diverse and could have recovery periods as long as several years. In most cases, aquatic life will return to its original level of productivity and diversity.

With respect to turbidity effects, silt carried into a surface water system by urban runoff will have a significant but short-term impact on aquatic life. The addition of silt to a surface water system will decrease the intensity of natural sunlight, which is needed to maintain the productivity of photosynthetic aquatic life. The significance of this effect will be less for estuarine systems than for fresh water systems. As a result of suspended silt carried into the system by river inflow and shoreline erosion, estuaries are naturally turbid. The turbidity level is usually high, caused by the active mixing and inflow/outflow action that is characteristic of most estuarine systems. This circulatory action enables excess silt to be eventually deposited onto shorelines, tidal flats, and sand bars. Fresh water systems are not that complex or variable as estuarine systems for their characteristics are predictable. Siltation is readily noticeable in fresh water systems, but the recovery period is short because the flow is unidirectional and a little mixing occurs. Fresh water aquatic life is generally more sensitive to turbidity changes than estuarine aquatic life. Appropriate measures should be mitigated to minimize this sensitivity during the construction phases of land development.

8.3.5 Land Features

(1) Physical and Chemical

The natural topographic features within the Grand Strand planning region will be altered slightly as a result of land development. This alteration is expected to cause minimal effect since the region is relatively flat with elevations ranging from sea level to 50 feet. Filling, excavating, and raising operations are expected to be the primary causes of altering the region's topographic features.

The proposed development of land areas within the planning region is expected to cause significant change in natural drainage patterns. Topographic contours and ridge lines may be altered by the construction of physical barriers (e.g., high-rise buildings, homes, retaining walls) as well as streets, sidewalks, parking lots, and highways. Most of the region's area is slated for residential, commercial, industrial, and institutional land uses as shown in Figure 3-11. Most of the natural drainage will be diverted into these developed areas. As a result, a sewer system of adequate capacity will be needed to convey the resulting storm water to a designated receiving system so that the storm runoff water will not accumulate and cause substantial flooding.

The pliocene-pleistocene-recent geologic deposits, which form the uppermost geologic formation, will not be affected by the proposed development of the Grand Strand region. The Pee Dee, Black Creek, and Tuscaloosa formations below this uppermost layer will not be affected either. Various land development activities such as excavating and drilling are not expected to be extensive enough to cause physical change in these formations and their water resources.

Soil conditions of the planning region will be beneficially rather than adversely changed, especially in areas where poor soil conditions exist for septic tank disposal. If environmental conditions are to be improved and preserved, the demand for wastewater facilities will increase as land areas are developed in the region. The availability of sewage treatment will eliminate the encroachment of septic effluents on the soil and improve the soil productivity. In contrast, soil erosion may occur because of excessive land clearing, and improper grading, or because of leaving the area unvegetated or unprotected. Since the slope of the land is proportional to the amount of erosion, appropriate measures should be taken during all construction phases of land development to mitigate soil erosion. These measures should be taken especially if the slope of land is or will be greater than 5 percent, as discussed previously in the sections on natural environmental setting and primary effects.

(2) Biological

As a result of the projected low density growth, most of the forestland, wooded areas, and undisturbed vegetated areas will be removed or affected by the proposed land development plans shown in Figure 3-11. This projected development will cause extensive depletion of the habitats and food resources of wildlife in the Grand Strand. The ability of the wildlife to successfully migrate to other forestland and vegetative areas is limited by the fact that these areas have already reached their carrying capacity and cannot support additional wildlife.

Although the Grand Strand region does not have any size-unique species of vegetation, the region does have several rare and/or infrequently found species. These species include the rose pogonia, the rosebud orchid, and the hooded pitcher plant, which are relatively abundant in the heavily moist areas of the planning region. Many other species of tropical plants that are very sensitive to environmental changes grow in the planning region, for example, the Venus-Flytrap can be found throughout the region, especially on the ridges of the Carolina Bays. The tropical plants of the Grand Strand region may suffer severe or permanent damage during the course of land development. Increased traffic and population causing additional dust and pollutant loading, indiscriminant land development, and alteration of natural drainage patterns will eventually cause a gradual disappearance of these plants unless appropriate mitigative measures are applied.

8.3.6 Atmosphere

(1) Air Quality

Increase of pollutants is usually attributed to an increase in industrial and commercial activities in an area induced by population growth. As a region grows, additional stationary and nonstationary pollutants are introduced because of increased fossil fuel (coal, oil, or natural gas) usage for heating, air conditioning, electricity generation, and increased transportation. The projected growth for the Grand Strand region is not expected to have an adverse effect on the region's ambient air quality, providing appropriate control measures are applied throughout the region and emission sources comply with Federal, state, and local regulations.

Presently, the Grand Strand region has good or high ambient air quality conditions, as indicated in Chapter 2 and as shown in Table 2-16. The region has been classified by the U.S. EPA as Class III under the nondegradation criteria for air quality. This regulation establishes three classes of sulfur dioxide (SO_2) and particulate pollutant levels specifying the allowable air quality deterioration limits for a particular region in the United States. The Class III designation sets the incremental increase levels (annual average) at 0.02 parts per million (ppm) for SO_2 and 60 micrograms per cubic meter (ugm/M3) for particulate matter. For evaluating the effects of growth on ambient air quality in the Grand Strand region, the primary sources of these pollutants are assumed to be the open burning of debris, incinerators, fossil fuel combustion units used for heating and cooling, and power plants generating electricity for the planning region. Heavy industry, another source of SO_2 and particulate pollutants, is not expected to be established in the planning region by 1997.

Although the population growth of the Grand Strand region is expected to increase from approximately 33,000 to 103,000 (permanent residents) by 1997, the SO_2 and particulate levels will only increase by approximately 67 percent, or two-thirds. This estimate represents a "worst case" condition and assumes one pollutant-producing source is added for each household or dwelling unit constructed, using a persons-per-household rate of three. Based on this assumption and using the Conway air quality data for 1974 as a baseline, the SO2 concentration will increase to 14 ugm/M^3 while the particulate concentration will increase to 60 ugm/M^3 (annual average concentrations). Thus, incremental increase is 6 ugm/M^3 for SO_2 and 24 ugm/M^3 for particulates. Both the annual average and incremental increases projected for SO_2 are well below the maximum limits established by Federal regulations. For particulates, the annual average concentration is equal to and could be greater than the allowable limit (Federal ambient air quality standards). Appropriate mitigative measures may have to be applied even though the incremental increase is below the EPA's nondegradation limit.

In addition to SO_2 and particulate level increases, the projected growth will increase other pollutant levels in the Grand Strand region as a result of increased vehicle traffic volume and vehicle miles traveled (VMT). These pollutants include nitrogen oxides (NO_2), carbon monoxide(CO), and hydrocarbons for which the estimated amount of increase is approximately 50 percent over present concentrations.

This estimate is based on the projected rise of VMT from 1,240,000 to 2,900,000, as cited in Chapter 3, and on the promulgated Federal emission standards for new automobiles. Although the implementation of emission standards has been delayed temporarily, these standards specify that emissions of CO, hydrocarbons, and NO_2 must be reduced by 50 percent. Those standards will most likely be put into effect within the next 20 years. Assuming that the 50 percent increase occurs by 1997, NO_2 and total oxidant concentrations (annual average) will be in the range of 24 to 25 ugm/M^3, which is still well below Federal ambient air quality standards. The base value used for this estimate is presented in Table 2-16 and represents Horry and Georgetown Counties. Base values or present air quality data for CO and hydrocarbons have not been determined as yet for these counties, therefore, estimates cannot be established for the potential 1997 concentrations.

(2) Noise

Vehicle traffic is presently the dominant noise source in the Grand Strand region. It will continue to be the dominant source as the region grows in population and development since the traffic volume on the region's major roads and highways could increase up to 55 percent as a result of growth. The resulting increase in noise levels is not expected to cause a significant impact on ambient conditions and residents. Based on the results presented in a report by the Highway Research Board, a doubling of the traffic volume would be required to cause a 3 to 5 dBA increase in the average noise level. A 5 dBA increase in noise level is the minimum increase and usually the point at which an effect can be defined.

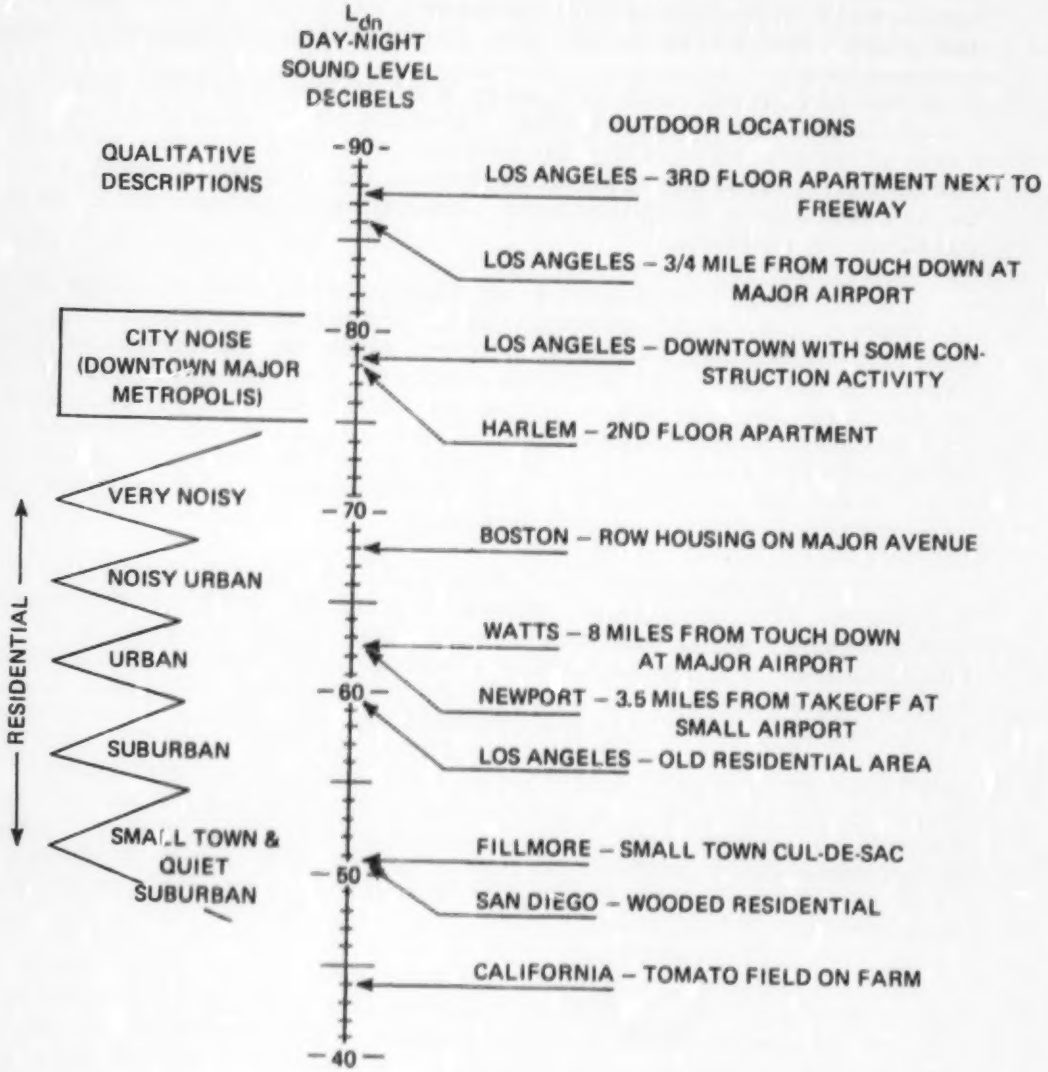
From an overall noise level standpoint, growth within the planning region could result in a 5 to 15 dBA increase by 1997. Figure 8-1 presents typical noise level values for various types of population areas. These values reflect the results from a recent study conducted by the U.S. EPA. In this study, noise levels were measured at selected locations within several major cities to study contributions from such sources as construction activities, major streets, and airports.

8.3.7 Sensitive Natural Areas

Most of the sensitive natural areas associated with the Grand Strand region will be affected by population growth

FIGURE 8-1

Qualitative Description of L_{DN} Measurements*



EXAMPLES OF OUTDOOR DAY-NIGHT SOUND LEVEL IN dB (RE 20 MICROPASCALS) MEASURED AT VARIOUS LOCATIONS and land development. The region's floodplains and forestlands will experience the severest effects, since the land use plans for these areas are residential, commercial and/or recreational. Beaches, wetlands, and the Carolina bays will also be affected, but probably much less severely than the floodplains and forestlands. The impacts of growth on the natural areas will vary in degree of significance and will range from adverse aesthetic appeal as a result of littering, to irreversible or permanent damage as a result of clear-cutting or grading.

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* SOURCE: "INFORMATION ON LEVELS OF ENVIRONMENTAL NOISE REQUISITE TO PROTECT PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY," U.S. ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF NOISE ABATEMENT AND CONTROL, MARCH 1974.

Over 1,500 acres of floodplains and 230,000 acres of forestlands will eventually be cleared, graded, and developed in the Grand Strand planning area to accommodate the expected growth. If a linear growth and development pattern is assumed for the next 22 years (1975 to 1997), approximately 70 acres of floodplains and 10,500 acres of forestlands will be developed each year. In this case the effects on these areas will increase until the development is completed or preservation measures are applied.

Construction and urban runoff may have a significant impact on the sensitive natural areas as well as on streams and rivers. Silt and other pollutants, such as oils and herbicides, may be carried to these areas or water systems and cause physical, chemical, or biological change. Depending on flow rate and distance, runoff could result in erosion and siltation of beaches, the Carolina Bay ridges, and wetlands at various locations. In addition, permanent damage to vegetation and changes in the chemical balance of the natural areas may occur. To mitigate these effects, appropriate measures should be used during the various phases of land development construction and after land development completion.

Potential growth impacts on the natural areas of the Grand Strand region are littering and indiscriminant dumping of unwanted household articles. The aesthetic appeal of the region's beaches, wetlands, and natural parks will be significantly reduced, and the effect will worsen as the population grows. Without proper controls (e.g. laws, ordinances), litter and/or discarded articles can become a major and costly problem, and mitigative measures should be taken.

CHAPTER 9

ADVERSE PRIMARY IMPACTS AND MITIGATIVE MEASURES

This chapter summarizes the more important unavoidable adverse impacts discussed in the two previous chapters and suggests mitigative measures. The mitigative measures follow each impact description.

9.1 NATURAL ENVIRONMENT

9.1.1 Water-Land Interfaces: Minor Decrease in Biological Productivity of the Floodplain from Construction and Operation of Treatment Plant C

During the construction stage, the potential threat to biological productivity would result from any contaminated runoff from the site. The runoff contamination can be easily avoided by adequate management of on-site sail moving operations and storage of construction materials.

Plant "C" is located in a floodplain. The plant will be raised to an elevation which would prevent overflow of most of the treatment apparatus during a flood. Only the sludge drying beds might be inundated during a flood, and the construction of sodded earth dikes around the beds would lessen the potential for contamination of flood waters with dried or drying sludge. Another mitigating measure would be removal of sludge from the beds to hauling trucks in advance of storm-caused flooding.

Another measure to lessen the potential for contribution to flood damage from plant "C" would be the secure storage of all treatment chemicals, such as settling agents and chlorine, to prevent the possible rupture of chemical containers during flooding.

9.1.2 Potential Erosion of Treatment Plant Sites and Interceptor Routes During Construction

Erosion of the treatment plant sites and interceptor routes can be easily avoided by using the following control methods during construction:

- Backfilling of any excavation as soon as possible with properly compacted soil, seeding or sodding the disturbed area promptly.
- Storage of excavated material which will remain on-site for future use in piles covered with waterproof material or surrounded by straw-bale dikes.
- Construction of sedimentation basins and sodded channels to the basins as required by drainage routes of runoff from the disturbed plant site. The construction of straw-bale dikes to intercept runoff flows may be adequate where rainfall is too low to require the use of sedimentation basins.

Where material for backfilling is borrowed from off-site, the use of existing borrow pits will minimize disturbance to the land. Where fill will come from an undisturbed area, appropriate stormwater control measures, such as those described above, will protect the excavation site and the area surrounding it.

9.1.3 Potential Change in Soil Characteristics

The proposed action calls for the drying of sludge to a form usable on golf courses as a replacement for commercially produced Milorganite, a fertilizer and soil stabilizer. Simple monitoring of its use on the area's golf courses would reveal any adverse effects. Where the dried sludge did cause adverse effects, the following would probably produce the desired remedies:

- Modification of the texture or moisture content of the dried sludge
- Modification of the method of application
- Change in the rate of application.

The application of the dried sludge may require some experimentation using the changes listed above, but optimum dried sludge characteristics and application methods can be expected to be found for all application sites. The effects on the soils should be the same as for the application of commercially produced Milorganite.

9.1.4 Potential Effects on Wildlife Habitats

While some wildlife will be displaced from the proposed treatment plant sites during construction, the adverse affects on habitats can be minimized by the following practices:

- Clearly defining the boundaries of the planned facility and keeping construction activity confined within the boundaries
- Protecting surface waters offsite where wildlife might drink by controlling stormwater runoff from the sites.

9.1.5 Atmospheric Environment

9.1.6 Effects of Odor on Residents

Odor control equipment is not specified by the Facilities Plan with the result that odors produced at the proposed plants will be largely a function of their compliance with proper operating procedures. Proper operation of the plants should result in no odor problem serious enough for residents to complain, except on the average of only two days per year. The development of adequate operating manuals, hiring of qualified plant operators, and on-site training of all plant personnel should contribute to the satisfactory operation of these plants.

9.1.7 Effects of Noise on Residents

Noise during the construction phase can be lessened by the following methods:

- Check all construction equipment for proper operation of exhaust systems and replace or upgrade the systems as required
- Schedule work so that no construction equipment is started until after 6 AM or some other time suitable to nearby residents

- Use the quietest type of equipment that will do the job; for example, electric equipment instead of diesel-powered equipment, hydraulic tools instead of pneumatic impact tools

- Schedule equipment to keep average noise levels low, to have noisiest operations coincide with times of highest ambient noise levels, and to keep noise levels relatively uniform during the work day

- Keep noisy equipment as far as possible from site boundaries

- Monitor noise levels at the boundaries of the site and set a maximum of 90 dBA or some other limit suitable to nearby residents

- Modify, shield, or reschedule equipment which raises noise from construction over the limit set in the previous step.

Implementation of these steps should control noise to levels of satisfaction to nearby residents.

9.1.8 Sensitive Natural Areas: Potential Disturbance to Carolina Bays and Buist Game Management Area

Construction of interceptors in the Buist Tract might disturb some Carolina Bays if damage to the same bays from land preparation for new development does not precede it. If the interceptors are constructed first, several mitigative measures are called for:

- Slight rerouting of interceptors in the Buist Tract, as drawn in the facilities plan, so that Carolina Bays are preserved.

- Comparing plans for rerouting of interceptors to plans for development of the tract. Considerable land preparation is expected during development of the tract, including the construction of extensive stormwater management works such as manmade lakes and ponds. Routing of the interceptors should be done in a manner compatible with development plans in order to avoid possible preclusion of environmentally sound development plans.

- Where interceptors must go through or very close to a Carolina Bay to keep to the land development plan for the tract, care should be taken to cause as little damage as possible so that the vegetation can replenish itself. The sandy ring around the bay should be restored as close to original condition as possible should it be disturbed during construction.

In order to lessen impacts to wildlife habitats and the hunting of game, construction of the interceptors should be accomplished at a swift rate so that wildlife does not change its habits in using the affected area. Any test holes in the soil or any other holes, trenches, or deep depressions caused during construction of the interceptors should be properly backfilled and compacted to prevent injury to long-legged animals such as deer.

9.2 MANMADE ENVIRONMENT

9.2.1 Land Use: Potential of Plant C For Incompatibility with Litchfield Country Club Community

An existing natural buffer of trees and understory vegetation shields the proposed site from the community. Expansion of the community in a westward direction would be compatible with the proposed plant if natural buffers of existing vegetation were left intact on the southern and eastern boundaries of the site.

9.2.2 Archeological Resources: Potential Loss During Construction

The designers of the 201 facilities plan obtained location and descriptions of all known existing archeological sites from the South Carolina State Archeologist. The routings of the proposed interceptors and locations of plant sites were made so that none of the known archeological sites would be affected by construction of the proposed facilities. However, the State Archeologist has determined that the probability of finding archeological remains on the proposed construction sites is high. Therefore, field surveys for archeological remains are being conducted according to EPA policy.[*] The survey for the Plant G site, outfall line and interceptor system has been completed and is presented in Appendix G. Surveys for the plant sites and outfalls for A and C are now underway and will be included in the Final EIS. Surveys for the A and C interceptor systems will be conducted during the design phases of these two projects. Any potential impacts to remains discovered during the survey or during construction can be lessened in the following ways:

- Set up a formal procedure for identifying archeological remains during construction and for reporting any finds to the State Archeologist
- Determine the informational and tangible values of all remains as swiftly as possible so that any necessary relocation of proposed facilities can be studied for cost and relative change in environmental impact
- Where it is determined that it is more effective to proceed with construction that would destroy an archeological remain, the remain should be studied thoroughly and any important material recovered.

9.2.3 Recreational Areas: Potential Disturbance to Golfers During Construction

The effects on golfers of construction of the pressurized wastewater transmission and treated effluent distribution systems can be lessened in the following ways:

- Control noise from construction in the ways suggested in Section 9.1.7
- Control dust by wetting down the disturbed area as required
- Proceed with work swiftly to minimize the time interval for impact.

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[*] Interim policy based on Section 106, National Historic Preservation Act of 1966, Executive Order 11593, and "Procedures for the Protection of Historic and Cultural Properties" (3c C.F.R. Part 800) issued by the Advisory Council on Historic Preservation.

9.2.4 Transportation: Potential Contribution to Traffic Congestion

Two methods for constructing pipelines across roadways were mentioned in Section 7.3: trenching and boring. Boring was rated as the preferred method. However, the soils of roadbeds in the planning area would likely preclude boring as a technically feasible and cost effective method. Trenching should prove to be a wholly adequate method. It can be done quickly, and steel plates can be laid over trenches to allow traffic to flow. Across Routes 17 and 501, trenching and laying of pipe can probably be done in two days with only one or two lanes blocked at any time. The following steps can be taken to reduce the potential increase in traffic congestion:

- Schedule work for periods of minimum traffic during the off-season for tourists, October to April
- Post notifications of the schedule for work on the roadway in sufficient time prior to construction so that motorists can choose alternative routes
- Post adequate warnings during construction and provide adequate traffic safety equipment such as barricades, signs, and flashers.

9.2.5 Other Projects in the Planning Area: Potential Burden of Proposed Action on Solid Waste Disposal System

The DHEC has made a study of suitable landfilling sites in and around the planning area. Few good sites were found. The DHEC, Horry County, and Georgetown County should cooperate in finding appropriate land filling sites for the disposal of screened out solids (grit) from the proposed treatment plants. These jurisdictions should also carefully monitor the sludge disposal operation at the area's golf courses to determine whether sludge should be landfilled instead. Any problems encountered with the disposability of the sludge product on golf courses or with its marketability could cause a large and sudden demand on landfill capacity. Therefore, the potential need for additional capacity should be recognized early and appropriate sites for sludge disposal should be found.

CHAPTER 10

ADVERSE IMPACTS FROM GROWTH: MITIGATIVE MEASURES

10.1 NATURAL ENVIRONMENT

10.1.1 Potential Degradation From Increased Runoff

Development under the alternative would substantially increase runoff, but septic tank effluent under the no action alternative would cause runoff to be lower in quality than under the proposed action.

The increased runoff which will result from new development may be great enough to warrant the formulation of comprehensive storm water management plans by Horry and Georgetown Counties. The need for such plans will be investigated in the ongoing 208 plan. The 208 plan will determine the need for storm water management structures, storage, treatment, regulation of discharge points, and changes to existing management plans, regulatory instruments, and regulatory agencies. The results of the 208 plan can be expected to be cost-effective and implementable methods for reducing the potential adverse impacts of increased runoff on surface waters.

10.1.2 Groundwater: Potential Decrease in the Availability of High Quality Drinking Water

The "Capacity-Use Study", sponsored by the U.S.G.S. and the South Carolina Water Resources Commission, will help to guide the future use of groundwater in the planning area. (See section 2.2 of this statement). When it becomes available, the study will contain recommendations on the proper location and construction of new wells and recommendations for relocating, reconstructing, or modifying existing wells so that potable groundwater use is optimized. Should regulation or allocation of groundwater use become necessary as the area grows, the State of South Carolina Water Resources Commission has the appropriate powers.

10.1.3 Water-Land Interface: Potential Degradation of Marshes and Beaches from New Development

Studies which are currently in progress by the Belle Baruch Institute and the South Carolina Department of Wildlife and Marine Resources should provide valuable data on the past and current stresses on marshland and beach life zones. This data and that contained in the first few chapters of this statement can be used to determine the need for regulation of landfilling in marshes and for setback requirements from the high water mark along beaches. Such regulation would probably be difficult to formulate but could serve to protect sensitive marshes and beaches.

10.2 MANMADE ENVIRONMENT

10.2.1 Potential Contamination of Estuaries by Increased Storm Water Runoff (Proposed Action)

Both Murrell's Inlet and Little River Inlet could be partially protected from increased runoff by the adoption of zoning or a land development control. The current "208" areawide planning process will consider the effects of existing and projected runoff on these areas and should result in cost effective plans for storm water management.

10.2.2 Archeological Resources: Potential Disturbance of Archeological Remains During Land Preparation for New Development

Public projects such as new highways will probably receive more attention for their potential archeological remains than will private development because field surveys prior to construction would be done where a high probability exists for finding remains. During construction of public projects, the possibility also exists that remains not found in the survey will be uncovered. Therefore, the adoption of a process for contacting the State Archeologist and for temporarily stopping excavation when remains are found would minimize the potential loss of valuable resources.

Private property developers should also be encouraged to exercise care in land preparation in order to protect archeological remains. The state might make information available to developers for preserving finds and reporting them to the State Archeologist. The Grand Strand Water and Sewer Authority might also make similar information available to developers when they apply for connection to the regional system.

10.2.3 Taxes and User Charges: Potential Escalation of Cost of Regional Facilities with Inflation

To protect the financial integrity of the proposed regional system and the ability of the Grand Strand Water and Sewer Authority to provide the necessary maintenance of the facilities, the user charges should be indexed to whatever rate of inflation prevails. This measure is part of the proposed action. It will assure that debt service requirements, payrolls, repairs, and maintenance of effluent quality are sustained during the life of the project.

10.2.4 Potential Inadequacies of Solid Waste Disposal Facilities

Georgetown and Horry Counties must continue to investigate additional landfill sites and alternative disposal technologies. For example, as suitable landfill sites dwindle and hauling costs rise, a pyrolytic solid waste system might prove feasible. Such a system would chemically degrade processed solid waste by applying heat, yielding recoverable gas of relatively high heat value and nearly inert residue. Successful systems of this type are currently in use.

10.2.5 Potential Incompatibility of Corps of Engineers Dredge Spoil Disposal Sites with Desired Uses of Land

The Corps is currently reevaluating its need for large tracts of land along the Intracoastal Waterway for future use for dredge spoil disposal. The Corps has access to these tracts under permanent easements from the State of South Carolina, and it is the state which must provide sufficient allocations of land to satisfy the Corps' need for disposal operations. Any reallocation of land by arrangements between the Corps and the state should consider both official land use plans and the future economic worth of the land for development in housing or recreational use. The potential for reclamation of existing disposal sites should also be an input to the Corps' reevaluation, as should be public opinion and the desires of the owners of the land for its future use.

APPENDIX A

Saltwater Fish Species
(Representative Common Species)

White shark	*Carcharodon carcharias*
Sharpnose shark	*Rhizoprionodon terraenovae*
Lemon shark	*Negaprion brevirostris*
Blacktip shark	*Carcharhinus limbatus*
Reef shark	*Carcharhinus falciformis*
Sandbar shark	*Carcharhinus milberti*
Smooth hammerhead	*Sphyrna zyganena*
Bonnethead	*Sphyrna tiburo*
Spiny dogfish	*Squalus acanthus*
Clearnose skate	*Raja eglanteria*
Southern stingray	*Dasyatis americana*
Bluntnose stingray	*Dasyatis sayi*
Atlantic stingray	*Dasyatis sabina*
Bullnose ray	*Myliobatis freminvillii*
Cownose ray	*Rhinoptera bonasus*
Ladyfish	*Elops saurus*
Tarpon	*Megalops atlantica*
Great barracuda	*Sphyraena barracuda*
Spanish mackerel	*Scomberomorus maculatus*
King mackerel	*Scomberomorus cavalla*
Wahoo	*Acanthocybium solanderi*
Atlantic bonito	*Sarda sarda*
Little tunny	*Euthynnus alletteratus*
Skipjack tuna	*Euthynnus pelamis*
Florida pompano	*Trachinotus carolinus*
Crevalle jack	*Caranx hippos*
Bluefish	*Pomatomus saltatrix*
Cobia	*Rachycentron canadum*
Black sea bass	*Centropristes striata*
Tripletail	*Lobotes surinamensis*
Atlantic spadefish	*Chaetodipterus faber*
Red drum	*Sciaenops ocellata*
Black drum	*Pogonias cromis*
Sheepshead	*Archosargus probatocephalus*
Atlantic croaker	*Micripogon undulatus*
Spot	*Leistomus xanthurus*
Southern kingfish	*Menticirrhus americanus*
Spotted seatrout	*Cynoscion nebulosus*
Weakfish	*Cynoscion regalis*
Southern flounder	*Paralichthys lethostigma*
Summer flounder	*Paralichthys dentatus*
Ocellated flounder	*Ancylopsetta quadrocellata*
Atlantic menhaden	*Brevoortia tyrannus*
Atlantic thread herring	*Opisthonema ogllnum*
Lizardfish	*Synodus foetaus*
Sea catfish	*Arius felis*

APPENDIX A
Continued

Gafftopsail catfish	*Bagre marinus*
Oyster toadfish	*Opsanus tau*
Spotted hake	*Urophycis regius*
Atlantic bumper	*Chloroscombrus chrysurus*
Pigfish	*Orthopristis chrysoptera*
Pinfish	*Logodon rhomboides*
Silver perch	*Bairdiella chrysura*
Banded drum	*Larimus fasciatus*
Star drum	*Stellifer lanceolatus*
Harvestfish	*Peprilus alepidotus*
Butterfish	*Peprilus triacanthus*
Searobin	*Prinotus* spp.
Hogchoker	*Trinectes maculatus*
Blackcheek tongue-fish	*Symphurus plagiusa*

Saltwater Turtles

Loggerhead sea turtle	*Caretta caretta*
Ridley turtle	*Lepidochelys kempi*
Green turtle	*Chelonia mydas*

Saltwater Mammals

Goose-beaked whale	*Ziphius cavirostris*
Atlantic common dolphin	*Delphinus delphis*
Atlantic bottle-nosed dolphin	*Tursiops truncatus*

APPENDIX B

Common Birds Which Frequent One or More Types of Coastal Salt Marsh in One or More Seasons of the Year

Pied-billed Grebe	*Podilymbus podiceps podiceps*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens virescens*
Little Blue Heron	*Florida Caerulea caerulea*
Great Egret	*Casmerodius albus egretta*
Snowy Egret	*Leucophoyx thula thula*
Cattle Egret	*Bubulcus ibis*
Louisiana Heron	*Hydranassa tricolor ruficolis*
Black-crowned Night Heron	*Nycticorax nycticorax hoactli*
Yellow-crowned Night Heron	*Nyctanassa violacea*
Wood Ibis	*Mycteria americana*
White Ibis	*Guara alba*
Mallard	*Anas platyrhynchos platyrhynchos*
Black Duck	*Anas rubripes*
Blue-winged Teal	*Anas discors*
Baldpate	*Mareca americana*
Ring-necked Duck	*Aythya collaris*
Buffle-head	*Glaucionetta albeola*
Marsh Hawk	*Circus cyaneus hudsonius*
Osprey	*Pandion haliaetus carolinensis*
Sparrow Hawk (Kestrel)	*Falco sparverius*
Clapper Rail	*Rallus longirostris*
Virginia Rail	*Rallus limnicola limnicola*
Sora	*Porzana carolina*
Coot	*Fulica americana*
Semipalmated Plover	*Charadrius hiaticula semipalmatus*
Wilson's Plover	*Charadrius wilsonia wilsonia*
Killdeer	*Charadrius vociferus vociferus*
Ruddy Turnstone	*Arenaria interpres morinella*
Spotted Sandpiper	*Actitis macularia*
Willet	*Catoptrophorus semipalmatus*
Lesser Yellowlegs	*Totanus flavipes*
Forster's Tern	*Sterna forster*
Black Tern	*Chlidonias nigra surinamensis*
Black Skimmer	*Rynchops nigra nigra*
Kingfisher	*Megaceryle alcyon alcyon*
Tree Swallow	*Iridoprocne bicolor*
Bank Swallow	*Riparia riparia riparia*
Purple Martin	*Progne subis subis*
Fish Crow	*Corvus ossifragus*
Long-billed Marsh Wren	*Telmatodytes palustris*
Boat-tailed Grackle	*Cassidix mexicanus*
Red-winged Blackbird	*Agelaius phoeniceus*
Savannah Sparrow	*Passerculus sandwichensis*
Sharp-tailed Sparrow	*Ammospiza caudacuta*
Seaside Sparrow	*Ammospiza maritima*
Song Sparrow	*Melospiza melodia*

APPENDIX C

Historical Sites of The Grand Strand

GEORGETOWN COUNTY - HISTORICAL

GE-1 WINYAH BAY JETTIES (public)

These stone Winyah Bay Jetties were constructed in 1898 to provide for a deeper channel into Georgetown Harbor. (Transportation).

GE-2 HOBCAW BARONY (private - Bernard M. Baruch Estate)
U.S. 17, 3 mi. N. of Georgetown

Hobcaw Barony was laid out in 1711 and was one of the first baronies divided by lot among the Lords Proprietors. In 1905, it was purchased by Bernard M. Baruch, financier, statesman, advisor to Presidents, and philanthropist. Mr. Baruch occupied the barony's main house from time to time and used it as a summer residence and hunting retreat; here he entertained many persons in the political, social and entertainment fields. Baruch served as Chairman of the War Industries Board during World War II and held many governmental posts under seven Presidents of the United States. During his later years, his interests turned to public welfare and he employed his fortune to foster many charities, one of which was the Baruch Center for the Physically Handicapped and a clinic in New York's Belleview Hospital. Mr. Baruch died in 1965 and left a portion of the 17,000 acre estate to the University of South Carolina and the Clemson University, to be put to use as a marine biological experimental center. This center is foremost in the area in the study of fauna and flora conservation. The main house is an impressive two and one-half story brick structure in the classical style with six free-standing white columns supporting the portico. (Political and Government Affairs) (Architecture) (Humanitarianism) (Science and Technology).

REF: South Carolina Department of Archives & History.

APPENDIX C
Continued

GE-3 GEORGETOWN MARKER (1) (private)
U. S. 17, 1 mi. N. of Georgetown

Erected in 1938, this marker commemorates General Francis Marion's attack on the Brittish garrison there in January of 1781. (South Carolina in the American Revolution).

GE-4 ARCADIA PLANTATION (private)
U. S. 17, 5 mi. N. of Georgetown

This architecturally outstanding Federal style plantation was built ca. 1785 and is one of the oldest and largest plantations associated with the Alston family. The gardens were originally connected with Prospect Hill; President James Monroe was a guest here in 1819. In recent years, the house has been owned by the George Vanderbilt family. (Agriculture) (Architecture) (Political and Governmental Affairs).

GE-5 WAVERLY PLANTATION (private)
U. S. 17 and Waccamaw River

This plantation was established before 1750 as a rice plantation with a mill. It has been owned by the Alstons and the Lachicottes. (Society: Manners and Customs).

GE-6 ALSTON-GRANT HOUSE (private)
Pawley's Island

This house is typical of the Pawley's Island style. The one and one-half story structure was originally built as a summer retreat for Governor F. W. Alston in 1845. (Society: Manners and Customs) (Political and Governmental Affairs).

GE-7 BARTOL-CALHOUN HOUSE (private)
Pawley's Island

This house may be one of the oldest on the island, although no records of ownership are available prior to 1866. Its architecture is typical of the Pawley's Island retreat. (Society: Manners and Customs).

REF: South Carolina Department of Archives & History.

APPENDIX C
Continued

GE-8 E. C. BOYLE HOUSE (private)
Pawley's Island

This house was built in 1854. (Society: Manners and Customs).

GE-9 BARNWELL-BOYLE HOUSE (private)
Pawley's Island

This house is situated on land granted by a Mr. Pawley to a Mr. Fraser in 1842. The house is typical of the Pawley's Island retreat and was constructed in 1880. (Society: Manners and Customs).

GE-10 LaBRUCE-LEMON HOUSE (private)
Pawley's Island

Dating from 1842, this house was probably one of a colony of summer houses built by prosperous rice planters of the Waccamaw Neck area; it has been changed little.(Society: Manners and

GE-11 WARD-PREVOST HOUSE (private)
Pawley's Island

This house was built in 1841 by Colonel Ward, on the the wealthiest rice planters in the country. During the period from its construction to the War Between the States, this house served as a summar academy for young men. (Architecture). (Education).

GE-12 NESBIT-NORBURN HOUSE (private)
Pawley's Island

This house, built by Dr. Robert Nesbit in 1780, remained in the family until 1950. Distinguishing architectural features are the northeastern dormers. (Architecture).

GE-13 WESTON ORTIZ E HOUSE (PELICAN INN) (private)
Pawley's Island

Originally constructed as a summer home in 1850, this structure is now a hotel known as the Pelican Inn. (Society: Manners and Customs).

GE-15 ALL SAINTS, WACCAMAW, EPISCOPAL CHURCH CEMETERY
(private)
2 mi. W of US 17

REF: South Carolina Department of Archives & History.

GE-15 This cemetery was in use prior to the Revolution, although no register of burials was kept until 1819. It was first created for the descendants of George Pawley (1699-1773). (Society: Manners and Customs).

GE-16 ALL SAINTS, WACCAMAW, EPISCOPAL CHURCH CHAPEL and PARISH HOUSE (private)
US 17 and SC 46

This church was established as a place of worship for slaves and is the last of thirteen slave chapels originally located on Cedar Grove Plantation. (Black History). (Religion/Philosophy).

GE-17 LITCHFIELD PLANTATION (private)
US 17, 16 mi. N of Georgetown

The earliest record for Litchfield is a plat dated 1794 which records the division of the land grant. The house was restored in 1926 to what is believed to have been its original lines. (Agriculture). (Architecture).

GE-18 WASHINGTON ALSTON MARKER (public)
Brookgreen Gardens

This marker was erected in 1941 by Georgetown County to commemorate Washington, artist and author during the late 18th and early 19th centuries. (Graphic Arts/Painting).

GE-19 THE OAKS CEMETERY (Brookgreen Gardens) (private)
Brookgreen Gardens (US 17)

The earliest marked grave in this cemetery is dated 1784; almost all of the persons buried here are descendants of John Alston (1666-1719). There is a marker there, too, dedicated to Joseph and Theodosia Burr Alston and their son, Aaron Burr Alston. (Society: Manners and Customs).

GE-20 BROOKGREEN GARDENS (private/public)
US 17, approx. midway between Myrtle Beach and Georgetown

These gardens contain over 350 pieces of sculpture executed by 175 artists, among them Anna Hyatt Huntington. There is also a native animal zoo in the gardens. Although George Washington passed through the area on his southern tour of 1791, present day Brookgreen Gardens dates from 1930; it has connections

REF: South Carolina Department of Archives & History.

GE-20 with the two greatest rice planting families in the state--the Wards and the Alstons. The gardens are now owned by the State of South Carolina and administered by a private board. (Agriculture). (Graphic Arts/Painting). (Political and Governmental Affairs). (Sculpture).

GE-21 THEODOSIA BURR ALSTON MARKER (private/public)
Brookgreen Gardens

This monument was erected in 1970 to commemorate Theodosia Burr Alston, the daughter of Aaron Burr and wife of Governor Joseph Alston. (Political and Governmental Affairs).

GE-22 WACHESAW PLANTATION (private)
Murrell's Inlet

Wachesaw Plantation is believed to have been developed by the Alston family. An Indian burial mound has been discovered at the site where the house stands and some artifacts have been excavated and preserved. (Society: Manners and Customs). (Aboriginal Americans).

GE-24 CEDAR HILL (private)
Murrell's Inlet

Constructed before 1837, Cedar Hill was the home of James L. Belin, who organized the Waccamaw Neck Mission for slaves. (Black History).

GE-25 SUNNYSIDE (private)
Murrell's Inlet

J Motte Alston had built an eight room house between 1848 and 1858. The frame was finished and moved across the river in flats and then hauled to the shore by oxen. There is in the house an oval stairway of solid mahogany which winds from the first floor to the attic. (Architecture).

GE-26 THE HERMITAGE (private)
Murrell's Inlet

The Hermitage was constructed in 1848 of long-leaf pine; each of the four columns supporting the portico is made from a single pine tree. The house has exquisitely detailed woodwork of intricate design. (Architecture).

REF: South Carolina Department of Archives & History.

APPENDIX C
Continued

HORRY COUNTY - HISTORICAL

HR-1 SOCASTEE ACADEMY SITE (public)
SC 707 and 544, Myrtle Beach

Many prominent Horry County citizens received their education at Socastee Academy. Originally a one room, rectangular building, it was constructed in 1830 and replaced in 1881. (Education).

HR-2 SOCASTEE UNITED METHODIST CHURCH (private)
SC 706 and SC 544, Myrtle Beach

The congregation originally worshipped in a log structure as early as 1818, which was rebuilt in 1875 of brick. The present building was constructed in 1951. (Religion/Philosophy).

HR-3 WITHERS MEMORIAL CEMETERY (private)
First Avenue, Myrtle Beach

Francis Withers was buried here in the late 1700's and it was also used by Eden Baptist Church. (Society: Manners and Customs).

HR-5 PINE LAKES INTERNATIONAL COUNTRY CLUB (private)
North Myrtle Beach

This 300 acre club was constructed in 1926 and is considered one of the finest on the east coast. (Society: Manners and Customs).

HR-6 SINGLETON SWASH and MYRTLE BEACH SALT (private)
Dunes Golf Club, North Myrtle Beach

This was a salt manufacturing industry active in the War Between the States; recent unearthings of ceramic gringing balls indicate that it was also a gunpowder factory, probably during the same period. (S. C. in the War Between the States). (Commerce).

REF: South Carolina Department of Archives & History.

APPENDIX C
Continued

HR-7 BEAR BLUFF SKIRMISH SITE (private)
Nixonville

This is the site of a skirmish between the Whigs and Tories during the Revolution. (S. C. in the American Revolution).

HR-8 CEDAR CREEK CEMETERY (private)
Nixon's Crossroads

Originally this was the location of a pre-Revolutionary meeting house. In the 1840's the Little River Methodist Church was built here and used until 1920. (Religion/ Philosophy).

HR-9 RANDALL VEREEN HOUSE (private)
Little River, US 17

This two story frame house with gabled roof is thought to have been built in 1830 and is located in the old fishing village of Little River. It has two large end chimneys. (Society: Manners and Customs).

REF: South Carolina Department of Archives & History.

APPENDIX D
Continued

7-3. Cox's Ferry Landing - A public boat ramp which is operated by the County.

7-4. Quail Creek Golf Course - A resort golf course for guests of certain motels. May be open to greens fee play.

7-5. Jackson Bluff Landing - A boat landing operated by a club.

7-6. University of South Carolina Regional Campus - The campus has tennis facilities which are open to the public.

7-7. Myrtle Beach National Golf Club - A resort golf course for guests of certain motels. May be open for greens fee play.

8-1. Ponderosa Family Campground - A commercially operated campground.

8-2. Sherwood Forest Campground - A commercially operated campground.

8-3. Lake Arrowhead Campground - A commercially operated campground.

8-4. Apache Family Campground - A commercially operated campground.

8-5. Holiday Inn Trav-L-Park - A commercially operated campground.

8-6. Arcadian Shores Golf Course - A resort golf course for members of certain motels. May be open for greens fee play.

8-7. Dunes Golf and Beach Club - A resort golf course that may be open for greens fee play. Tennis facilities are available.

8-8. Myrtle Beach

Birch Canoe Family Campground - A commercially operated campground.

Pebble Beach Family Campground - A commercially operated campground.

Springmaid Family Campground - A commercially operated campground.

Myrtlewood Golf Club - A resort golf and tennis club for guests of certain motels. May be open for greens fee play.

Pine Lakes International Country Club - A resort golf and tennis club. May be open for greens fee play.

Chapin Park - A city operated park with tennis facilities.

Executive Motor Inn - Motel that has tennis facilities open to the public.

Pepper Geddings Memorial Recreational Center - Public tennis facilities are available.

Hillside Tennis Courts - Public tennis facilities are available.

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APPENDIX D
Continued

11-1. Peachtree Landing - A public boat ramp which is operated by the County.

11-2. Socastee Recreation - A fishing facility which is operated by a club.

11-3. Wacca Wache Marina - A commercially operated marina. A public boat ramp is available.

12-1. Lakewood Family Campground - A commercially operated campground.

12-2. Ocean Lakes Family Campground - A commercially operated campground.

12-3. Surfside Beach
Floral Park - A public baseball field.
Surfside Drive Park - A public park with tennis and basketball facilities and tot lots.
Surfside Fishing Pier - A commercially operated fishing pier.

12-4. Yogi Bear Family Campground - A commercially operated campground now under construction.

12-5. Garden City
Garden City Pier - A commercially operated fishing pier.

12-6. North End of Murrells Inlet - A state approved public shell fishing area and oyster beds.

12-7. Allston Creek - A state approved public shell fishing area and oyster beds.

12-8. Murrells Inlet - A state approved public shell fishing area and oyster beds.

12-9. Murrells Inlet - Several commercial marinas and boat landings are located here. Many of the marinas have boat rentals and charter deep sea fishing boats.

12-10. Clambank Flats - A state approved public shell fishing area and oyster beds.

12-11. Litchfield Country Club - A resort golf and tennis club which may be open for greens fee play.

17-1. Hagley Landing - A private boat landing open to the public.

17-2. Sea Gull Golf Club - A resort golf club open for greens fee play.

APPENDIX E

From the Files of the Institute of Archeology & Anthropology USC - Site Survey Records

Site No. (Map No.)

38HR4 Location: 150' W of L immediately inside South western
(H4) portion of Air Force Base fence.
Description: Site is a backdirt pile for a drainage ditch containing 2 historic sherds of ironstone in close proximity with 1 blue glass bottle neck fragment. Shell is abundant.

38HR5 Location: Approximately 150 yds S of Rt. 801 & 100 yds W of
(H5) Hy 17.
Site Description: An aboriginal ceramic site found in the disturbed areas and backdirt piles of a land clearing & borrow pit operation.

38HR6 Location: 220 yds NW of Hy 17 & 50 yds E of Hy 17.
(H6)
Description: Site is a concentration of 2 plain sherds within a 10' sq. area.

HR13 Location: Along US 17, 4 mi S of its junction with a side
(H 13) road leading to Ocean Drive Beach.
Material observed: 57 potsherds, 3 projectile pts., other stone artifacts.

HR14 Location: Waiter Island North of causeway on island.
(H 14)
Description: 3-lobed sand mound w/shell vaneer.

HR15 Location: At end of Rt. 236 at Little River. Site at end of
(H 15) road in front yard of house.
Description: Confederate earthworks.

HR16 Location: E of 17 & W of Rt. 559 between Lake Arrowhead &
(H 16) Intracoastal Waterway. 10 mi N of Myrtle Beach.
Description: Shallow midden.

HR17 Location: Long Lake. Briarcliff, on Long Lake, freshwater
(H 17) behind the sand dunes.

HR18 Location: Ellsworth Garden Site. Briarcliff acres between
(H 18) 17 and Intracoastal Waterway 12 mi N of Myrtle Beach.
Description: Extensive pottery on sloping hill that goes down to a little lake.

APPENDIX E
Continued

HR19 Location: Windy Hill Beach at Point Creek.
(H 19)
Description: Pottery and site in road Hy. 17 entrance to White Point restaurant, 1 block N at Windy Hill City Limits.

HR20 Location: On point of land on Marsh east of Hy. 17 near Point Creek on Windy Hill Beach.
(H 20)

HR21 Location: Big Rise, West, U.S. 17 N at South City limits sign to Windy Hill Beach adjacent to Windy Hill Beach City garbage dump.
(H 21)

HR22 Location: Lakewood School at end of 394 along SW shore of Platt Lake.
(H 22)
Description: aboriginal ceramics.

HR23 Location: N of U.S. 17 and S of Prices Swamp run near an artificial lake on Briarcliff Acres.
(H 23)
Description: similar to HR 21.

GE2 Location: Smith site: just W of 17 below the Georgetown Horry County line, South of road turning west, north of Creek.
(G 2)
Description: Sandy field adjoining racetrack.

GE4 Location: Murrells Inlet Air Force mooring.
(G 4)

GE14 Location: Litchfield Beach. Beneath and around house at Litchfield Beach.
(G 14)
Description: Fragments of wood and metal found in excavating for house foundation.

GE15 Location: Pawleys Island House. Old house located at end of southern causeway from mainland.
(G 15)

GE1 Location: Rosts Canal. Located at Litchfield Beach.
(G 1)

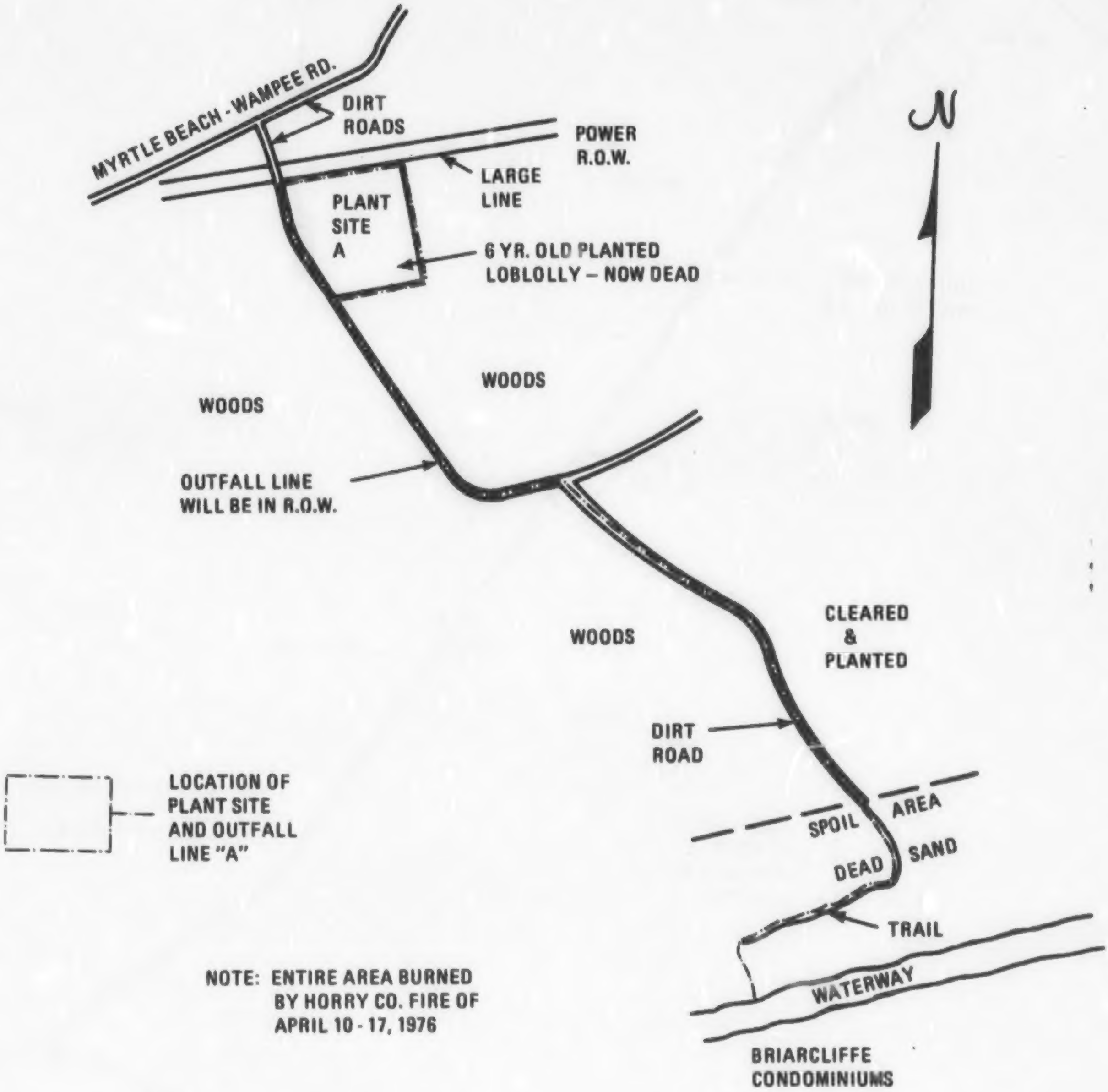
GE3 Location: Horse Glen Marsh. Murrells Inlet.
(G 3)
Description: sherds and shells.

GE7 Location: Wachesaw Landing.

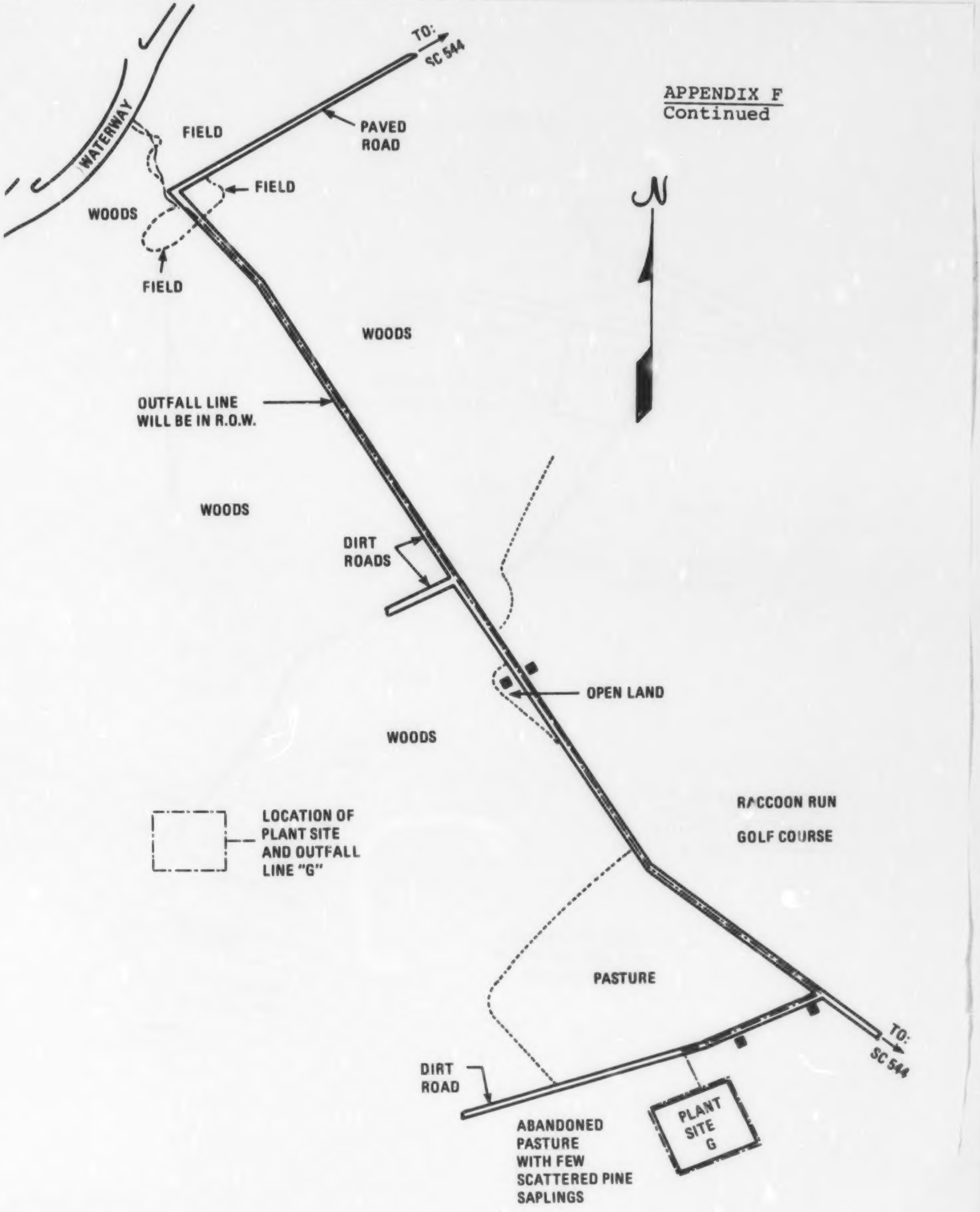
GE16 Location: East of Hy 17 on inlet of creek 3/4 miles below Georgetown Horry County line.
(G 16)

GE17 Location: Clambank 2 miles north of Winyah Bay on side of Clambank Creek; 2.5 miles east of Bellefield.
(G 17)
Description: sherds.

APPENDIX F


MYRTLE BEACH - WAMPEE RD.
DIRT ROADS
POWER R.O.W.
LARGE LINE
PLANT SITE A
6 YR. OLD PLANTED LOBLOLLY – NOW DEAD
N
WOODS
WOODS
OUTFALL LINE WILL BE IN R.O.W.
WOODS
CLEARED & PLANTED
DIRT ROAD
SPOIL AREA
DEAD SAND
TRAIL
WATERWAY
BRIARCLIFFE CONDOMINIUMS
LOCATION OF PLANT SITE AND OUTFALL LINE "A"
NOTE: ENTIRE AREA BURNED BY HORRY CO. FIRE OF APRIL 10 - 17, 1976

APPENDIX F
Continued


TO: SC 544
WATERWAY
FIELD
PAVED ROAD
FIELD
WOODS
FIELD
WOODS
OUTFALL LINE WILL BE IN R.O.W.
WOODS
DIRT ROADS
OPEN LAND
WOODS
RACCOON RUN
GOLF COURSE
LOCATION OF PLANT SITE AND OUTFALL LINE "G"
PASTURE
TO: SC 544
DIRT ROAD
PLANT SITE G
ABANDONED PASTURE WITH FEW SCATTERED PINE SAPLINGS
N

APPENDIX G

REPORT
ON AN
ARCHAEOLOGICAL SURVEY
in
regard with prehistoric and historic sites
located in
Horry and Georgetown County
of South Carolina
to be affected
by
the construction of
THE CENTRAL WASTEWATER TREATMENT PLANT
Phase I
Interpretation based on
the
Final Plan
of
Black, Crow, and Eidsness, Inc.
conducted by
Reinhold J. Engelmayer, PhD
Professional Archaeologist
May 9, 1976

INTRODUCTION

The project area surveyed for this report is designated Phase I in the "Final Plan for Regional Wastewater Facilities for the Grand Strand Region (project no. 685-74-50)" prepared by Black, Crow, and Eidsness, Inc., Consulting Engineers, for the Grand Strand Water and Sewer Authority, Conway, South Carolina. The surveyed area covers geographically Waccamaw Neck from Murrells Inlet , in the South up to (including) Myrtle Beach Air Force Base and Red Hill in the North, bordered on the West by the Waccamaw River and in the East by the Atlantic Ocean. The treatment facility and transmission system will serve the Myrtle Beach Air Force Base, Surfside Beach, Garden City, Murrells Inlet, and the surrounding areas.

Map references given in this report are based on the detailed maps provided for this survey by Black, Crow, and Eidsness: Sheets 1 - G through 23 - G, 13 B, and one unnumbered sheet showing the changed course of the outfall from Wastewater Treatment Plant G into the Waccamaw River, which replaces 16-6.

The survey covered all transmission corridors, sites of pumpstations, and the site of the new wastewater treatment plant in area "G" of Phase I and Phase II.

Actual on-the-ground survey of the project area started on Monday, May 17 and ended Thursday, June 3, 1976. Several sites were rechecked on June 6 and June 8, 1976.

A total of 50 miles of sewage line corridors (due to the change in the outfall from Wastewater Treatment Plant "G"), 26 pump stations, and the site of the new wastewater treatment plant were surveyed. Calculating a corridor of seven feet wide for the sewage lines and the outfall, hundred by hundred feet for the pump stations, and 411,000 sq. feet for the new treatment plant (according to the blueprint) a total of 3,134,900 square feet were surveyed and tested.

SURVEY OUTLINE

a) Resource Survey:

An examination of the Site Survey Files of the Institute of Archaeology and Anthroppology of the University of South Carolina in Columbia (of which copies are kept at the Archaeological Field Station on Arcadia Plantation) did not show any recorded prehistoric or historic sites located in areas affected by the wastewater facilities plan.

The files of the Horry County Archaeological Site Survey (kept by Dr. Frank Sanders of Conway, at present being mapped by the Archaeological Field Station) did not show any record of prehistoric or historic structures located in the affected areas.

The records of the Horry County Historical Society and the resource files of the Horry County Memorial Library in Conway were of great help in providing information in regard with the cemetery located near Longwood Landing, which is described later. Otherwise no historic structures or reference to prehistoric sites ("mounds", etc.) were found. The County Court House Records Department in Georgetown could not provide any pertinent information, since all records prior to 1865 burned during the War between the States.

The records Department in the Horry County Court House provided information in regard with the historic cemetery and historic structures located near Longwood Landing. Otherwise their records did not show any historic structures located, in the affected areas. The Mouzon Map of 1775 did not show any structures located in the affected areas, neither the Mill's Atlas of South Carolina of 1825. However, the U. S. Coast Survey Map of 1853 (Sketch E, Survey of Section V) showed some tenant houses located on the side of the road near Longwood Landing (the site of the cemetery).

The Post Route Map of 1896 does not give any indication of historic structures located in one of the affected areas. Finally, the topographical maps of the US Geological Survey were consulted without revealing any information in regard with sites to be affected.

In addition, interviews with property owners and older people in the ares living on, or close to the proposed corridors and construction sites, were conducted in order to find out if they would have any knowledge about finds of prehistoric artefacts, archaeological sites, or historic structures. Only in the case of the historic cemetery, these interviews proved to be fruitful.

Aerial photographs from 1939, 1973 and 1974 were also consulted to see if any unusual features existed in the affected areas. In addition soil maps of Georgetown and Horry County were checked against some of our core samples drilled during the archaeological survey.

This research was done prior to the beginning of the on-the-ground survey. After the on-the-ground survey some of these resources were checked again.

b) On-The-Ground-Survey

The field archaeologist, one field assistant, two crew members and one soil specialist were conducting the archaeological survey and testing. The entire

50 miles of sewage lines corridors were walked the entire length at a width of 7 feet. All sites identified by surface finds of prehistoric or historic nature were plotted on the map, recorded by photography (black and white and color) and subsurface samples taken to determine the extent of the site. A standard 3 1/4 inch augur was used for sampling the subsurface stratigraphy. Due to the groundwater table in the area, the depth of this cores did not exceed 150 centimeters; in most instances along the corridors the groundwater table was reached at 38 to 50 centimeters.

Test trenches (30 cm wide) were dug from time to time to determine archaeological features. High ground areas having no surface finds were tested with the augur to make sure no subsurface sites would be overlooked.

The recorded material was examined and analyzed at the Archaeological Field Statio with the help of representative material excavated in the Grand Strand Area.

The sites were given a site number and site survey sheets for each site will be forwarded to the Institute of Archaeology and Anthropology in Columbia to be added to the Archaeological Site Survey of the State of South Carolina.

RESULTS:

The greatest part of corridors and pump stations were located along existing highways and roads. Nearly all of the areas adjacent to the highways and roads proved to be completely disturbed ground. However, artefacts from such areas were recorded and plotted even when testing did show that the site as such had been destroyed.

Reproduced from best available copy.

A total of 18 prehistoric sites and 3 historic sites were found to be located on proposed sewage line corridors and the outlet to the Waccamaw River (site designated 38 GE 40 and 38 HR 37 - 53 and 38HR 54-56). No archaeological site is found on the acreage designated as the site of the Wastewater Treatment Plant.

PREHISTORIC SITES:

The material from these sites consists of potshards of the Deptford and Wilmington stage (500 B. C. to 700 A. D.). Decoration of the majority of the potshards is cord marked and check stamped; the material is of a reddish brown color and sand-tempered. A smaller amount of corn cob-decorated pottery is tempered with crushed potshards. No lithic material was found with these artefact assemblies. Also no faunal and floral remains were found, perhaps due to the disturbed character of the sites, exposure to detrimental environmental conditions, and the nature of the ground (high acidic soil and sand).

HISTORIC SITES:

A small tar kiln (38 HR 54), two meters in diameter and about 50 cm high, is located on the south side of "Wells Road", connecting Longwood Landing with the community of "Freewoods". The construction of the dirt road has destroyed most of it.

In the corridor of the proposed outlet from the sewage treatment plant two historic cemeteries are located (38 HR 55 and 38 HR 56). One of them (38 HR 55) is an extensive Negro cemetery, with few grave stones, but about 20 depressions in the soil indicating the presence of graves. The oldest grave stone of the Small family, who according to an interview with Henry Small (according to his recollections born before 1900) was mainly buried here, dates to 1900 (Saxpy) the latest grave stone shows the date March 18, 1951 (Pauline Small Weston).

Separated from this cemetery to the north by a natural drainage cut is another cemetery which contains two important graves: Samuel V. Hemingway, who died Novemver 20, 1851 and John Green, who died at Vauxhall February 23, 1839.

Both persons are of great historic interest, as the grave of John Green might give a clue to the still unidentified location of the plantations he owned (Vauxhall, Oak Hampton, and others) and the history of his family, which was prominent in Georgetown County.

The burial of Samuel V. Hemingway has excited the interest of the Williamsburg Historical Society. The Hemingway family, after which the city of Hemingway in Williamsburg County is named, up to now, was not able to trace their family back before 1870, when the first member of this name came to Williamsburg County. The Williamsburg Historical Society will begin work on this cemetery immediately, and Mrs. Mary Reid from Kingstree will research the graves in the weeks to come. Besides these two graves marked with head stones, there are several depressions around, which indicate the presence of more graves.

CONCLUSION AND RECOMMENDATION:

No further work will be necessary on the prehistoric sites and the remains of the tar kiln located on, or close to the proposed corridors of the sewage lines and the outlet, to mitigate any adverse affects of the project: All of these sites are disturbed or destroyed to such an extent, that they do not provide any major contribution and do not have any major importance to the cultural heritage of the State.

In regard with the two cemeteries it is strongly recommended, that the corridor of the outlet be changed slightly to the north to mitigate the adverse effects the construction of this sewage line would have. Both cemeteries are of great importance for the history not only of the county, but furthermore for the history of the State and every effort should be made to preserve them.

UNIVERSITY OF SOUTH CAROLINA
COLUMBIA, S.C. 29208

INSTITUTE OF ARCHEOLOGY AND ANTHROPOLOGY

June 11, 1976

Mr. Glenn W. Du
Black, Crow and Eidsness, Inc.
P.O. Box 1225
Myrtle Beach, South Carolina 29577

Dear Mr. Dukes:

I have taken the opportunity to review the report on the archeological survey of Phase I of the Myrtle Beach Wastewater Treatment Plant prepared by Reinhold J. Engelmayer. I have also asked two of our other staff archeologists to individually review the report also. We have had essentially the same comments.

This report is, indeed, entirely satisfactory for the purposes of the initial, preliminary report immediately following the survey and should be satisfactory to get your project underway. This report, of course, is not a final archeological report for the purposes of your contract with Dr. Engelmayer. I am sure he is aware of this and is intending to prepare the archeological report separately as is the usual procedure.

You will recall that I mentioned to you in my letter of April 22nd concerning Dr. Engelmayer's proposal that a two week period was not sufficient for analysis of the specimens and site records and the preparation of a proper archeological report. I am sure Dr. Engelmayer is fully aware of this. In the archeological report of the 21 sites located in this assessment some of the things that should be needed would be the following:

1. listing and description of the artifacts and other archeological material found at each site;

2. interpretation of what those materials mean in terms of the cultural context that they represent;

3. which sites were tested and by which means, either the 3 1/4" auger or 30 cm trenches and how long and deep the trenches were and so on;

4. 19 of the sites are listed as being already destroyed or partially destroyed. We would want to know in what way they were destroyed, whether by buildings, highways, or whatever and to what extent in each individual case;

5. there needs to be a summary synthesis of the significance of these 21 sites and the archeological sequence of the coastal area of South Carolina.

As I say, I presume Dr. Engelmayer will provide this more extensive report for you within the framework of this contract.

There would also have to be scholarly bibliographical references quoted throughout the text which I think should have even been in this brief preliminary report. Mention is made of such things as the Mill's Atlas and various dated maps, but without bibliographical references. Also on page 5, the prehistoric material is listed as Deptford and Wilmington. These also should have bibliographical references. I presume the date on the cover of the report (May 9, 1976) is a typographical error since the work was done between May 17 and June 8, 1976. Apparently the report should have been dated June 9th rather than May 9th.

I hope this will be satisfactory for your purposes. I am enclosing for your information a xerox copy of some of the guidelines for this kind of professional archeological assessment.

Sincerely yours,

Robert L. Stephenson
Director and State Archeologist

RLS:mls

Enclosure

cc: Dr. Reinhold J. Engelmayer